

IMMERSIVE MEDIA

A STATE OF THE INDUSTRY

May 2017



VR/AR Project

vrarproject.com

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V1	Seth Shapiro	2015
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USC School of Cinematic Arts



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PREFACE

I

This project began in June of 2015, as a collaboration between my student Andriy Pishchalenko and I. We both wanted a reason to learn more about the rapidly-changing virtual and augmented reality space, where I'd been spending more time, and had friends doing great work.

Although the idea of virtual reality had been around since the 1980s, this time there was a platform. The rise of mobile, the increase of inexpensive processor power, and the ubiquity of both web and social meant that there was a floor beneath the movement. It felt the same way the Internet had felt around 1992—before the browser, when believing in the transformative power of the Internet was still a minority view—a cottage industry on the threshold of a tsunami.

The best way to learn about something is to write about it, so Andriy and I dug in, and tried to summarize the industry. Version 1 took about eight months; even then, the results were rudimentary. We came back to it six months later, and released Version 2 in March of 2016.

For this 3rd edition, Bryce Paul's editorial contributions were invaluable, and Andriy continued to play a critical role.

Perisa Brown, John Canning, Amy Dai, Xingting Gu, Hudson Leiser, Francisco Serna, and Kinsey Thompson provided great research that drastically expanded version three of the project.

We would also like to credit Alice Shen and Michael Hoydich for the valuable community resource included in our Investments section.

Many thanks to Casey Jones for his elegant design and layout work, and to De Ivett of 5D Spectrum for her web development work.

Many thanks to the USC School of Cinematic Arts, my department patrons Larry Auerbach and Bonnie Chi, and our interviewees: Grant Anderson, Gabo Arora, Willow Bay, Xing Chung, Chris Edwards, Robert Hernandez, Aaron Koblin, Yelena Rachistky, Ted Schilowitz, and Eric Shamlin.

Are you a
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Virtual, augmented, and mixed reality represent the next great era of media beyond TV and online video.

Virtual reality refers to computer-generated experiences designed to mimic reality in an enclosed environment. A well-constructed VR environment embeds physiological cues to meet the human perceptual requirements for feeling real as opposed to traditional, 2D screen-based experiences. VR can be accessed from head-mounted displays (HMD) powered by a mobile device, computer, or game console. Unlike 3D, with which VR is often compared, the best VR experiences represent a new type of experience, in which the viewer is surrounded or immersed in an environment.

While VR encloses the viewer in a different world, **augmented reality** opens and extends the user's *real environment*. Whereas VR generally transports viewers into an otherworldly experience, AR adds new digital layers onto one's existing field of vision, enhancing the physical world with more information or choices.

AR and VR may be best understood as the two endpoints on the continuum of mixed reality. In a true **mixed reality** environment, physical and digital objects co-exist and interact in real time, and are anchored to a point in space. MR enables users to move around a digitally rendered object, just as if they were walking around a real physical object. In MR environments, physical and digital content co-exist and interact in real time.

The massive implications of these three sectors are outlined below.

While VR closes the viewer in a different world, **augmented reality** opens the world and extends the user's real environment.



This section presents an overview of some of the most innovative companies in their respective fields. It highlights established brands that are incorporating VR and AR, as well as startups who are developing this emergent tech. **This is by no means exhaustive.**

ADVERTISING & MARKETING

Companies are using VR and AR to extend brands—the best works focus on creating entirely new experiences. Effective VR generates visceral reactions because the audience is completely immersed in an environment, *free from distraction*. [Studies](#) show interactive and immersive ads outperform static pre-roll in completion, engagement, awareness, and brand recall rates.

The strength of immersive advertising lies in its intimacy. For instance, it is much more effective to offer a virtual first-person test drive than to watch someone else do it on TV. For example, [Lexus](#), [Volvo](#), [Audi](#), and [BMW](#) are heavily invested in this form of marketing.

VR/AR technologies also enable eye tracking. This information can be useful in constructing heat maps to further refine, personalize, and target ads. Moreover, the same ad experience can be deployed in a variety of different environments: in-store, in the home, in social media, and in B2B demos.

Marketers must select tactics that align with brand's overall strategy, to achieve maximum ROI.

CreateVR

Sony Pictures teamed up with [CreateVR](#) to create a companion experience for their movie *The Walk*. In *The Walk VR*, the user relives Philippe Petit's terrifying walk between the two World Trade Towers. When [CreateVR](#) originally demoed *The Walk VR*, they added haptic elements: a cut hose on the floor to simulate the wire, and a fan to simulate wind. As a result, at least 30% of viewers just could not bring themselves to walk more than a few feet.

MediaMonks

In a multi-million-dollar campaign, [Etihad Airlines](#) hired [MediaMonks](#) to showcase their new onboard, first class lounge

VirtualSKY reports highly engaged audiences; for their custom built 360 VR ads, completion rates are at about 30-50%.

in VR. This lavish, high-budget ad with Nicole Kidman has the production value and sheen of a major motion picture. They have also created experiences for Google Tango, Audi, Toyota, Chrysler, Samsung, and Lego.

Mssng Peces

Digital agency [Mssng Peces](#) leverages their video story telling expertise, creating VR and 360° for brands including Chevrolet, NBA, and Dos Equis.

VirtualSKY

[Airpush](#), a mobile advertising leader that is integrated into over 150,000 mobile apps, recently announced a new platform called [VirtualSKY](#). VirtualSKY reports highly engaged audiences: for their custom built 360 VR ads, completion rates are at about 30-50%. In comparison, Airpush typically sees 2-4% rates on their traditional mobile video ads.

Vertebrae

[Vertebrae](#) is a VR advertising network that connects brands with audiences in a similar fashion. Their platform helps content creators and publishers monetize by connecting them with consumers. Vertebrae's major publishing partners include CBS, NFL, Facebook, Huffington Post, and Fox News.

VNTANA

[VNTANA](#), a AR Hologram startup, uses data-driven results to service brand clients. They create hologram advertisements that consumers can interact with. Data is then collected about

"The Walk VR"
Create VR



how consumers reacted to and engaged with the experience. Additionally, VNTANA collects email addresses for brands, from potential customers.

AEROSPACE & DEFENSE

Aerospace & Defense are early adopters of VR/AR, as the incredible value of flight simulators became an early driver for VR R&D.

While VR has been especially valuable for flight and combat training, [AR is proving its value here as well](#). For example, soldiers in the field can view real-time information from a variety of sources (satellites, cameras, etc.) in a hands-free manner. A HUD information system enables them to navigate a combat situation or even civilian encounters. For pilots, the [F-35's \\$400,000](#) helmet is a major AR advancement. The display integrates angling, noise canceling, and night vision, so that the pilot is fully aware of the jet's vitals, and surroundings.

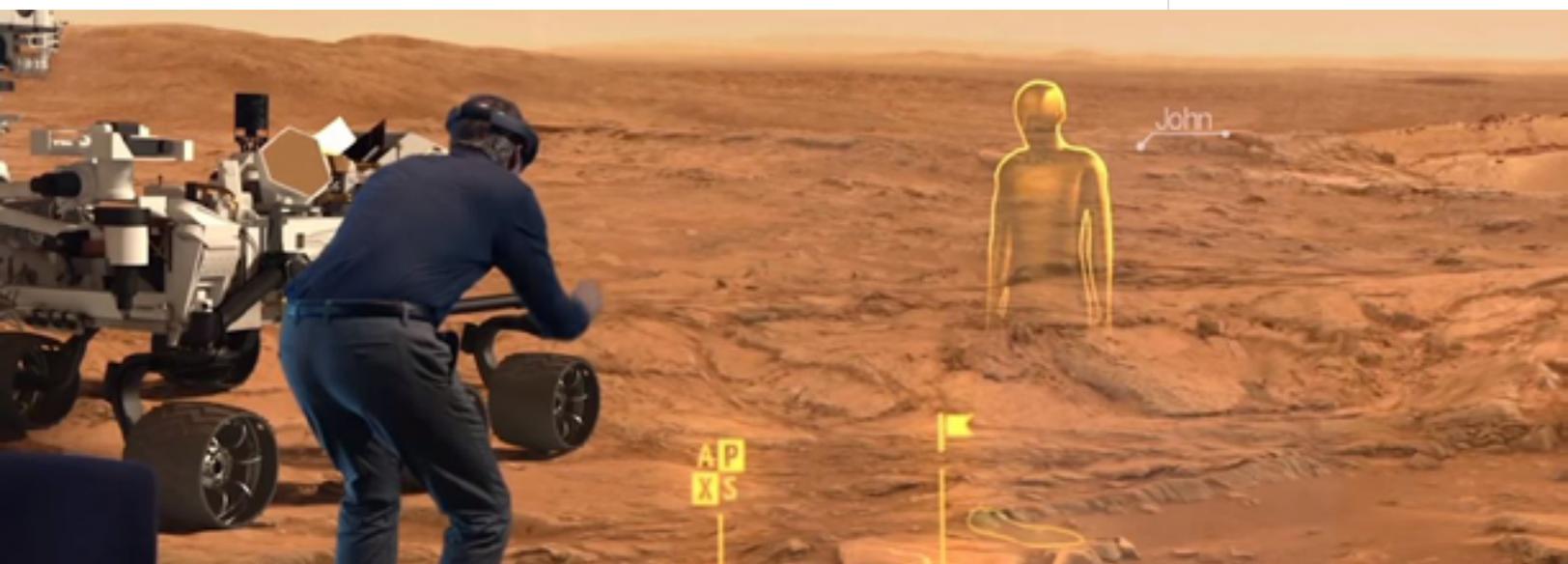
Cubic Global Defense

Cubic Global Defense's [Immersive Virtual Shipboard Environment](#) (IVSE), is an advanced learning product for the Littoral Combat Ship training program. IVSE puts trainees in a photo-realistic 3-D virtual environment that teaches tasks in settings virtually identical to real-life scenarios.

Experius

VR/AR production studio [Experius](#) is creating advanced combat simulators. Their solution leverages volumetric capture from segment leader [8i](#), photogrammetry, and 3D audio. Users can switch between a standard video game environment and an Experius photogrammetric environment, in order to see the stark difference between the two technologies.

"Destination Mars"
NASA



Experius' recent *Navy SEAL Experience* provides lifelike combat situations. In addition, users will also be able to stand eye to eye with a battle-worn Navy SEAL soldier, and walk around him to view him at any angle as he performs basic duties.

NASA

For over 60 years NASA has been training astronauts to fly, work, and live in conditions beyond the Earth's atmosphere. NASA uses VR/AR technologies to train astronauts to spacewalk via a solution called SAFER (Simplified Aid for EVA Rescue) with simulated jetpacks. Using a combination of an HMD, haptic feedback gloves, and motion trackers, NASA's VR Lab gives the astronaut a virtual experience of working outside the International Space Station.

NASA has not stopped experimenting, and has added VR technology to train, educate, and inspire. Anybody can now experience [astronaut training, a walk on Mars with a HoloLens](#), or see [a rocket launch from a unique perspective](#).

CONSTRUCTION

VR enables companies to show clients a finished building before a single brick has been laid. The idea of virtual construction sites is time honored: construction companies have long used laser scanning and rendering via building information modeling (BIM) and CAD. However, because drawings and renderings fall short in capturing the three-dimensional nature of buildings, designers would construct scaled down physical models. This is time consuming and costly.

Now, companies and their clients can explore both the interior and exterior of a project, and make changes to the design plan before construction begins. Further, VR's social capabilities enable those involved in a project to meet in a virtual jobsite and walk through it together in real-time.

[Simultaneous Localization and Mapping](#) (SLAM) technologies are being integrated into AR, resulting in a reduction of time spent comparing blueprints to ongoing construction sites. Instead of using slow laser tripod scanners, SLAM systems use sensor data to track location and map the space around it, usually through LIDAR, which measures distance to an object using laser lights. The key advantages here are real-time rendering and non-dependency on GPS.

Lastly, another issue that VR offers a remedy for—is dispute from local citizens who are worried about the effects that a construction site will have on the local environment. VR can be helpful in this regard by offering VR tours to locals, showing them

VR enables companies to show clients a finished building before a single brick has been laid.

what building will look like, and how it will affect property prices, landscape, traffic, safety, and collective health. Surveys at the end can generate valuable feedback in early stages.

Gilbane Building Company

With the ability to identify future problems during construction, AR headsets simply pay for themselves. When constructing the Dearborn STEM Academy in Boston, [Gilbane Building Company identified a serious issue beforehand](#): the steel frames they had on order were slightly too long to fit the design. On blueprints and 2D digital displays, the mistake slipped through the cracks. But when the company's senior manager put on the HoloLens to see a mockup of the project, the mistake was obvious: "That one catch paid for the HoloLens," he said.

Among other construction and architecture companies who have announced experimentation with the HoloLens: the engineering

Designing with Microsoft
HoloLens



firm AECOM, the design and architecture firm Gensler, and the China State Construction Engineering Corporation.

McCarthy Building Companies

One example of a successful and efficient usage of VR is the construction of the Martin Luther King Multi-Service Ambulatory Care Center in LA. Prior to construction, doctors and nurses wore VR headsets, and were encouraged to provide input on logistical details of the rooms.

As stated by the [VP and CIO of McCarthy Building Companies](#), "even seemingly simple decisions like where the equipment connections are located on the wall behind the bed, where a trashcan is located, how wide the gaps are between beds, or what furniture goes can be extremely important. In this project, we

saved a significant amount of time making these decisions early, and avoiding going in circles or installing something that would need to be changed later.”

Paracosm

[Paracosm](#), a robotics company, plans to take 3D scanning even further, using robotics and drones do full building scans.

EDUCATION

VR has been used already in tens of thousands of classrooms, in progressive schools and learning labs throughout the U.S. and Europe. So far, VR usage has centered on the hard sciences, enriching interaction and focus on dimensional objects: human bodies, animals, molecules, environments, and architectural models. However, educators are also finding VR to be beneficial in the realm of virtual field trips.

CGO Studios

[CGO Studios](#) is a virtual reality production company focusing on creating high-quality, photo-realistic moments of history in VR. The team’s initial experience, appropriately titled FIRST, was the first-ever historically curated recreation in VR. This piece showcases the Wright Brothers epic achievement of flight, and incorporates curation from the leading experts on the subject at the Smithsonian National Air and Space Museum. CGO’s current projects include an Anne Frank experience (with curation from the Anne Frank Foundation in Basel) and a recreation of the first summiting of Mt. Everest by Sir Edmund Hillary and Tenzing Norgay, called Everest '53.

Google Expeditions



Google Expeditions

VR can give students a glimpse into the past and/or other places in the world. To expand on this, Google launched [Expeditions](#) accessible via smartphone. This project gives schools the materials they need to take students on a VR field trip.

Nearpod

In a similar vein, [Nearpod](#) is creating pre-made lessons based on VR field trips. There are over 4,000 ready-to-teach interactive lessons for all K-12 grades and subjects—from, U.S. history and digital citizenship to algebra and science— created by Nearpods' community of educators and partners. These lessons are available in the proprietary Nearpod Library.

Moreover, Nearpod is already in use in [10,000, or 10% of, U.S. schools](#). They are also working to bridge the gap for the largest growing student demographic: non-native English speakers. In one of the largest English Language Learner districts in the country, Nearpod provides teachers with more than 500 lessons designed for these students.

YouVisit

[YouVisit](#) is a virtual reality touring business with several applications. Their platform allows prospective students to virtually tour the campuses of collaborating universities. The service claims to result in increased physical campus visits, applications, and yield rates. Harvard, Columbia, Princeton, and Yale are among participating institutions.

ENTERTAINMENT

Entertainment is clearly the most widely discussed sector of VR/AR. Content is produced for and distributed across a range of form factors, including 360 video, mobile, and HMD/room scale. The content already occupies a wide range of genres, including games, fiction, fantasy, journalism, politics, and travel.

[Littlstar](#), [Jaunt](#), [NextVR](#), [TransportVR](#) by Wevr, [im360Vr](#), [Digital Domain](#), [Within](#), [SteamVR](#), [Viveport](#), [Oculus Store](#), [Daydream](#), and [YouTube360](#) are some of the most prominent platforms.

INVASION!
Baobab Studios



The following is a small sample of leading content companies, and some well-known projects. A fuller list can be found in section 17. Notable Projects.

Baobab

[Baobab](#) is a VR studio that creates cinematic and character driven narratives. The company was founded by Maureen Fan, former VP of games at Zynga, and Eric Darnell, the director of many DreamWorks animated features including the *Madagascar* franchise. Baobab's cinematic experiences include [Rainbow Crow](#), [Asteroids!](#), and [Invasion!](#).

Felix and Paul

[Felix and Paul Studios](#) focuses on creating high-end cinematic virtual reality experiences. Founded by Emmy-award winning directors Felix Lajeunesse and Paul Raphael, the studio creates original stories, including *Strangers* and the series *Nomads*. The studio collaborates with franchises and famous personalities, including *Jurassic Park*, LeBron James, and President Barack Obama. Their signature emotive cinematic experiences are made possible by the company's proprietary 360 camera rig and accompanying software.

Google Spotlight Stories

Google created [Spotlight Stories](#) to develop experimental short films and animations in virtual reality. The 360 videos are distributed via the Spotlight Stories app on both iOS and Android. Currently, all the videos are free. Their landmark film [Pearl](#) was nominated for an Academy Award for Best Short Film (Animated).

The Martian VR Experience
Virtual Reality Company & 20th
Century Fox



Here be Dragons/Within

Chris Milk, (with Aaron Koblin) co-founded production company [Here Be Dragons](#) and its sister company, Within. Both focus on live-action and animated VR content. The content ranges from documentaries to music videos, including many award winners. Content from both companies is distributed via Within's iOS and Android app.

Jaunt

[Jaunt](#) develops both hardware and software to enable cinematic VR. The Jaunt One, Jaunt's premier camera, allows for high quality 360-degree capture coupled with 3D sound-field microphones. At their Los Angeles based production studio, Jaunt creates both live action and animated content, and distributes through its app. In September 2015, Jaunt received a major investment from Disney.

Oculus Story Studio

[Oculus Story Studio](#) is a virtual reality film studio that creates original animated experiences. The company was founded in 2014 by Edward Saatchi and Pixar veterans Saschka Unseld and Max Planck. The company is best known for its interactive VR short, [Henry](#), which won an Emmy for Original Interactive Program. The studio also developed [Quill](#), an "infinitely scalable VR canvas" where users can sketch and paint "immersive worlds and tell stories in an entirely new way."

Penrose Studios

[Penrose Studios](#) is focused on both augmented reality and virtual reality storytelling. The studio wants to be "the Pixar of VR/AR", creating massive cinematic experiences. Founder Eugene Chung put together an ace team with employees from DreamWorks, Oculus, Disney, and Google. Their most acclaimed work is [Allumette](#), the heartwarming story of a girl, her mother, and a city in the clouds.

theBlu:Whale Encounter
Wevr



Secret Location

[Secret Location](#) is an award-winning studio that creates content across the web, mobile, tablet, VR, and AR. The studio developed [Sleepy Hollow: VR Experience](#), the first VR experience to win an Emmy. Secret Location has worked for many clients including Red Bull, Samsung, Mitsubishi, Nickelodeon, MGM, Endemol, Sony Pictures, and Toyota.

Virtual Reality Company

[The Virtual Reality Company](#) is a content studio that focuses on VR experiences by combining “technology, art, and storytelling”. The Virtual Reality Company is founded by an all-star team and focuses on episodic and long-form content. Advisors to the company include Steven Spielberg and James Howard. Look out for the company’s VR experience, *Raising a Ruckus*, later this year.

Wevr

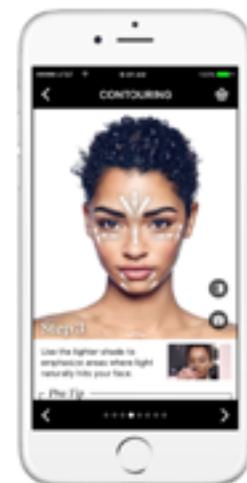
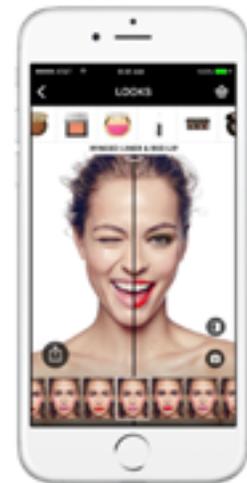
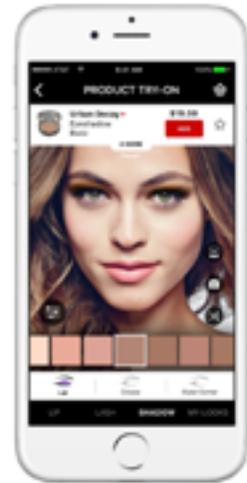
Wevr is both a content creation studio and a distribution platform for live action and animated VR content. Wevr’s most notable VR experiences include [theBlu: Whale Encounter](#), which premiered at the 2016 Sundance Film Festival, and [Gnomes and Goblins](#), in conjunction with John Favreau. Recently, Wevr created [TransportVR](#), an independent network for VR creators to share their work.

FASHION

In fashion, augmented reality is emerging as a new way for brands to delight and engage customers. Many retailers are developing AR apps, allowing customers to try on virtual items before they buy. The reach doesn’t stop at traditional fashion brands— even niche markets within retail are jumping on the opportunity to deliver unique shopping experiences.

Perfect Corp.

The YouCam app is created by the app developer [Perfect Corp.](#), which has a range of mobile beauty apps including YouCam Makeup, YouCam Perfect, YouCam Nails, Beauty Circle, and YouCam Fun. The apps have collectively [generated over 300 million unique downloads globally](#), establishing Perfect Corp. as a leading figure in the AR beauty movement. Through its suite of mobile apps, the company connects brands to consumers across the entire retail experience, from product discover and virtual try on, to social sharing and mobile commerce. Since its launch in March 2014, users have taken a combined 10 billion photos across the apps, and spend over 500 million minutes per month taking photos with the camera feature.



“Sephora Virtual Artist”
Sephora

Gap

Gap unveiled an AR app, "[The Dressing Room by Gap](#)," which allows users to visualize Gap products on a virtual mannequin. Gil Krakowsky, VP Global Strategy and Business Development at Gap, explained in an interview: "This is how it works: shoppers choose a Gap style that they might be interested in purchasing. Next, they select one of five body types featured in the app so they can "try on" the piece of clothing from anywhere on a Google Tango-enabled device, and if they love it, they can buy it online."

Sephora

Cosmetics company Sephora introduced the "[Sephora Virtual Artist](#)" in an update to its existing iOS app. Developed in a partnership with AR company ModiFace, the feature allows users to try on makeup looks through facial scanning. Once a user has found a look they like, they can purchase the products used within the app itself. The app also features "virtual tutorials" which overlay instructions of how to apply the products on the user's face.

Further, product review and tutorial videos account for a large share of YouTube's popular content, suggesting that Sephora's style of virtual tutorials are strongly positioned to become a leading AR genre.

FINANCE

VR and AR "[represent new channels](#) for financial services providers—wealth managers, brokerage firms, and personal bankers—to deliver financial content in a novel and easily consumable visual format."



Traditional financial institutions are losing the trust of their core, wage-earning customer base. At 84 million, millennials are the largest demographic in American history. According to the [Millennial Disruption Index](#), a three-year study that surveyed 10,000 millennials about 73 companies in 15 industries, the banking sector was found to be at the highest risk of disruption. In particular, millennials have fundamental dissatisfactions with the retail-banking customer experience. Whether it's sending a wire, applying for a loan, or signing up for a credit card, millennials are inclined to do it all online, avoiding brick-and-mortar banks at all costs.

However, most will eventually need some type of professional financial advice for complex dealings, such as home mortgages and trusts. To address this, customers could visit virtual reality branches from inside of their home. Virtual branches have huge capacity to revolutionize customer relations by offering a new service for clearer and enhanced communications.

Just as online banking enabled customers to use live chat and email to contact bankers, virtual reality branches will give customers a new way to interact. Ultimately, banking will be easier, more engaging, and more efficient for each party. Interactions would be avatar to avatar, whereby bankers can present offers, advice, simulations, spreadsheets, graphs, charts, and other examples in real-time.

Comarch

[Comarch](#) uses VR in their wealth management software to make trading tools easier to use and more accessible. Being able to visualize data and potential outcomes helps their customers make better investment decisions, rather than looking at spreadsheets.

Citi

[8ninths](#) has created holographic workstations for [Citi's](#) stock market traders, utilized through Microsoft HoloLens. According to 8ninths, the pain points addressed include lack of prioritization within six to eight screens of 2D information, lack of easily discernible centralized knowledge, inefficiency in navigating between windows and tabs, inefficiency in recognizing critical patterns and market changes, loss of opportunity for collaboration and dialogue, and loss of the "human element" and the "feel of what is going on in the market."

Fidelity Investments

Fidelity Investments ideated [StockCity](#) for Oculus Rift (also viewable via browser), a tool that applies virtual reality and data visualization to help investors manage their finances. It turns any

According to 8ninths, these were the pain points addressed: lack of prioritization within six to eight screens of 2D information, lack of easily discernible centralized knowledge, inefficiency in navigating between windows and tabs, inefficiency in recognizing critical patterns and market changes, loss of opportunity for collaboration and dialogue, and loss of the "human element" and the "feel of what is going on in the market."

given portfolio into a virtual city, in which each stock is represented by a building. The height and footprint represent the price, trading volume, and outstanding shares. This is just one way in which Fidelity is attempting to connect with younger generations. “If you want to deliver a great customer experience, you have to be in the same kinds of environments where they are,” says Seth Brooks, Director of Product Management at Fidelity Labs.

GAMING

Games are the low hanging fruit in VR entertainment. They have been the entertainment industry’s main driver, holding the largest growth and revenue promise.

Game worlds have always been about transporting the player to different worlds and environments. VR provides a natural extension of the worlds gamers have enjoyed exploring.

On the production side, the most robust VR environments are created with game engines. Both Oculus and Vive have their base in the gaming community. All one has to do is look at the launch and acceptance of the PSVR to see the dominance: [in 2016, the PSVR sold more units than Oculus and Vive combined](#). All three platforms are expanding their content offerings beyond the core gaming category. Some of the leading game companies include the following.

Capcom

[Capcom](#) is a Japanese game publisher that has been publishing games since the ‘80s, with titles including Street Fighter, Devil May Cry, and Resident Evil. The latest release of the Resident Evil franchise is [Resident Evil 7](#). Released on PSVR in 2017, the game received a lot of buzz and positive reviews. Many players claimed that they couldn’t complete the initial chapters because of how intensely frightening it was. Audiences can feel trapped inside the headsets while seeing through the eyes of the protagonist. This reaction is something that even the best movies haven’t been able to elicit, and bodes well for the development of horror VR projects going forward.

CCP

Icelandic publisher [CCP](#) created EVE Online, a highly successful space based MMORPG (Massively Multiplayer Online Role Playing Game). The company then developed two new titles based on the same IP—[Gunjack](#), a virtual arcade shooter for Samsung Gear VR (and subsequently Vive and Oculus) and a more sophisticated VR experience, [EVE: Valkyrie](#). EVE: Valkyrie is a multi-player dogfighting space game that is achieving mainstream popularity. Despite initially mixed critic reviews, consistent free updates and

Game worlds have always been about transporting the player to different worlds and environments. VR provides a natural extension of the worlds gamers have enjoyed exploring.



cross-platform support have spurred sales and enthusiastic audience response, [recently breaking even on their \\$30m investment](#) into the space.

Crytek

The German video game and software developer [Crytek](#) is known for games like Far Cry and Crysis, which both showcase the companies powerful CryEngine. [The Climb](#) is a popular Oculus exclusive featuring VR climbing. This game shows off the power of VR to transport users into hyper real environments, POV perspective, and adrenalin pumping action. Subsequently, Crytek has released [Robinson](#) which is a sci-fi adventure. Both games highlight the power of Crytek's game engine for developing VR games.

Epic Games

[Epic Games](#) is widely known for their Unreal game titles, and even more so for their Unreal engine, which powers many CGI based VR experiences. [Robo Recall](#), an Oculus exclusive, is an arcade-style shooter that has players dodging and returning gunfire while taking advantage of the powers of teleportation to navigate the universe. The game offers simple yet addicting gameplay and competes with similar titles like [Arizona Sunshine](#). Robo Recall is the evolution of one of Epic Games' earlier tech demos for the Rift called [Bullet Train](#), which was one of the first to take advantage of the newly designed Oculus Touch controllers.

NUX Studios

This Swedish based game company was established in 2016 with a core team focused on developing the VR and AR space. In their first game, [Wands](#), players use one of several wands, each with its unique spells, and duel other wizards online. In between battles, users can develop their skills and explore new spells and combinations. The more battles one wins, the more spells and abilities are unlocked. There is also a spectator feature to watch others battle in real time. It is available on Google Daydream, Samsung Gear, PSVR, and Vive.

Owlchemy Labs

[Owlchemy](#) was bought by Google in May 2017. The studio is best known for their breakout VR hit, [Job Simulator: The 2050 Archives](#). This cartoon-style game consists of several "job simulations,"

which stick players in various work environments such as a garage, restaurant kitchen, or a corporate office. They can interact with different objects found in the space, as well as complete tasks such as fixing an engine or preparing food. Players have the freedom to accomplish those tasks in a wacky or unorthodox way if desired. Actions are performed via the hand controllers with relative ease.

Job Simulator was well received for its uniquely fun take on an interactive VR experience, and managed to make over [\\$3M in sales](#) in roughly half a year. It also spawned a spin-off game based on the [Rick & Morty TV show called the Rick and Morty Simulator: Virtual Rick-ality](#). This game puts players in the shoes of the character Morty, and allows them to explore and interact with crazy objects and characters from the Rick and Morty TV universe.



Survios

[Survios](#) was established in 2013 by a group of USC students with the focus on VR games. Their first game release, [Raw Data](#), is one of the most polished titles on the market, and the first consumer VR game to reach \$1M in sales. The multiplayer co-op shooter effectively takes advantage of the room-scale capabilities of the HTC Vive to give the player freedom to perform evasive maneuvers while blowing up robots. The game illustrates the potential of multiplayer VR gaming and the potential for E-sports to grow out of competitive social VR experiences.

“Job Simulator: The 2050 Archives”
Owlchemy Labs

Valve Corporation

[Valve Corp's](#) content distribution platform Steam is the largest digital game distribution platform for PCs, reaching 14 million concurrent users this January. In 2015, they partnered with HTC to create the Vive platform, and established the Vive as the leading VR gaming platform. Valve has now expanded their partnership to other HMDs starting with LG.

HEALTHCARE

Healthcare is currently one of the most fertile and rapidly growing areas of VR and AR. Use cases include surgery assistance, remote diagnostics, surgery simulation, phobia treatment, phantom limb pain (PLP) treatment, robotic surgery, data visualization, and skills training.

AppliedVR

[AppliedVR](#) is focused on bringing therapeutic practices to hospitals. Their mission is to offer "an enjoyable escape from scary and painful experiences in healthcare." Their platform offers games, virtual travel, music visualization, nature meditations, and sports. AppliedVR expects their technology to reduce anxiety in pre-op waiting rooms; increase the comfort of patients who are receiving an IV, local anesthesia or regional block; and reduce pain, anxiety, and discomfort over the course of certain procedures as well as during post-op periods. Overall, they aim to increase patient satisfaction. [AppliedVR cites](#) that games reduce general clinical anxiety at a 63% rate, and found that patients reported reduced pain by 24% after experiencing VR for 20 minutes.

BioFlightVR

[BioFlightVR](#) offers a wide range of medical VR and AR medical training services. One of BioFlightVR's main applications is

Patients using AppliedVR therapy



the uploading of data in VR to increase accuracy of diagnoses; their platform allows doctors to view CT scans and MRI data as interactive, immersive, 3D images. These imaging tools reveal details that are often overlooked.

Another one of their main applications is the creation of VR experiences which take users through organs in the body. This helps patients understand their illness or health issues. This kind of experience stimulates a lasting, positive change. For instance, the company created an experience designed for cigarette smokers trying to quit, taking users through the mouth, lungs, heart and other organs to see firsthand the damage done by smoking.

ImmersiveTouch

[ImmersiveTouch](#) is a surgical virtual reality company that trains and improves the precision of surgeons for minimally-invasive procedures, and is FDA approved. It is used as an education platform for pre-surgical planning, and mission rehearsal for several types of procedures. The company cites that it reduces surgical errors by about 54%.

One Caring Team (Aloha VR)

[Aloha VR](#) is focused on assisting the elderly community through VR. There are no puzzles, objectives, or storylines. Aloha VR offers several beautiful and soothing scenes—a simple escape from reality for those who have difficulty leaving home.

OssoVR

[OssoVR](#) is a platform designed for surgical training, particularly in the orthopedic market, with plans to expand into other specialties and procedures. OssoVR is equipped with advanced hand-tracking on the Oculus Rift or HTC Vive. Ultimately, OssoVR is an affordable alternative to surgery simulators that can cost up to \$250k.

Doctors using the Oculus Rift to view 3D images of the body
Surgical Theater



Scopis

[Scopis](#) is a next-generation Target-Guided Surgery System that overlays digital images onto a surgeon's endoscope, which informs them of the mapped-out pathway.

Touch Surgery

[Touch Surgery](#) already boasts a community of 1.5 million users of its mobile surgical simulations, and recently formed a partnership with DAQRI to add compatibility with their hardware. This partnership has great potential as it is fundamental that a surgeon has as much information as possible during a procedure; if a doctor is wearing an AR headset, he could navigate several bits of vital information about his patient without having to move or look away. When combined with other sensing technology, AR can greatly enhance the surgeon's perception of the procedure by overlaying real time info.

Virtually Better

[Virtually Better's](#) mission it to treat common fears such as heights, storms, public speaking, elevators, bridges and flying. They offer programs to help clinicians treat a specific phobia using different scenarios. Each program gradually exposes the user to a phobia, as a supplement to graduated exposure. Such a controlled environment allows practitioners to expose their patients to a gradient of simulations and coach them on how to cope with their feelings. By putting patients through the memories over and over, the patient overcomes the memory as repetition and expectation reduce their impression of the situation.

LIVE EVENTS

Livestreaming in 360 is now possible over Facebook, YouTube and Periscope, for owners of consumer 360/VR cameras. Samsung has led this effort for their Samsung Gear camera, featuring famous YouTubers like Casey Neistat in commercials, and having them create 360 content. Samsung's hope for this campaign is that it will bolster interest in creating 360 content (using Samsung's camera). New consumer 360 cameras releasing in 2017 will have relatively simple workflows with automatic stitching and sleeker post-production editing tools.

Most custom professional cameras like the ones used by [NextVR](#) and [Voke](#) have their own unique post-production software for stitching and editing, and are more resource heavy as they deal with a greater number of lenses shooting in higher resolutions. Other companies offering professional systems that are capable of livestreaming include Nokia's Ozo, 360 Rize Black Magic setup,

New consumer 360 cameras releasing in 2017 will have relatively simple workflows with automatic stitching and sleeker post-production editing tools.

Liveplanet and Vuze. The simplest “prosumer” 360 camera is the OraH 4i with a form factor similar to consumer cameras, utilizing only four lenses and shooting in 4K.

IM360

[IM360](#) is Digital Domain's VR branch. They specialize in live 360 streamed experiences, and offer a full proprietary end to end solution.

LiveLike

[LiveLike](#) takes a different approach to viewing “in VR.” They utilize traditional cameras with wide angle lenses to capture gameplay, and then stream the gameplay in a virtual viewing box through a headset, where multiple friends can join and pretend they're sitting in a suite at the actual stadium.

The experience allows for multiple viewing angles and social interaction between viewers, and has been received good reviews via the Fox Sports VR mobile app. In the past year LiveLike has streamed multiple NCAA football and basketball games for early adopters, and plans to stream the Roland Garros tennis championship this summer.

Livit

[Livit](#) is a 360 streaming partner that works with a variety of live camera solutions and stream content via a white label player. Their player can be embedded into either web or mobile app solutions.

NextVR

[NextVR](#) has closed the most deals in the space so far, teaming up with FOX Sports, NBA, NCAA, NHL, ICC Soccer, NBC Sports, US OPEN Tennis, and LiveNation to stream live games and concerts in VR. These livestreams will be made available through the NextVR mobile app on iOS and Google Play. They currently offer compatibility with NBA League Pass, providing access to 3-4 livestreamed games a month. Their goal is to grow their subscription service and offer them through larger channels in the future. Their main goal is to scale, but one bottleneck persists: current smartphones and consumer HMDs can't stream at high resolution, due to their relatively low res displays and the bottleneck of current 4G data networks. However, in the next year and going forward, 4K resolutions and higher will become the standard, and by [2021 5G coverage should be gaining traction](#).

Pixvana

Encoding also plays a major role in streaming content through the data pipeline. [Pixvana](#) built their own processing pipeline to improve encoding and editing speeds for high resolution 360 content. Improvements in display resolution, data network speeds, and encoding will all significantly improve the quality of live action and livestreaming 360/VR content in the future.

Voke

[Voke](#) was acquired by Intel for their “Immersive Sports” offering. Among several other projects, Voke has streamed professional and college sports games, the Critics’ Choice Awards, and the “Project Runway” finale.

VRLive

[VRLive](#) is a 360/VR production entity focused on live events (music, events, sports, etc.). They use a wide variety of gear, based on the project and output to clients’ desired platforms.

REAL ESTATE

The main use case for VR in real estate is in offering potential home buyers fully immersive virtual tours. These virtual tours are extremely effective in preselling spaces, and giving consumers a true feel for the space.

Macerich

[Macerich](#) used VR to showcase some of its early stage projects, including its 500,000-square-foot luxury Fashion Outlets of San Francisco near Candlestick Park.

Matterport camera 3D scanning



Matterport

Currently, [Matterport](#) is leading the way with volumetric 3D scans of entire homes. Matterport's 3D scans can be viewed on a desktop or thru an HMD. According to [Matterport](#), these virtual tours generate 95% more leads and 3x time spent on site. They've created over 200,000 virtual spaces, which have generated over 50 million visits. However, the process is very expensive: the camera itself is \$4,500 on top of a \$50-150 monthly fee.

Sotheby's International Realty

[Sotheby's International Realty](#) has started to produce 3D scans to enable virtual walkthroughs, viewable both via web browser and HMD. Currently they are taking advantage of the Samsung Gear VR technology to distribute.

Transported

[Transported](#) is also developing solutions for VR tours, available on Samsung Gear and Oculus, with HTC Vive, Google Daydream and Cardboard apps coming soon.

VR Global

[VR Global](#) provides the commercial, mixed use, and residential real estate markets with easy to use applications. Their applications combine 3D rendered models, CGI, and 360° content that is accessible via VR and AR environments as well as web and mobile. They also offer customized white label applications designed specifically for real estate agencies, sales agents, developers, designers, architects, and creative agencies.

RETAIL

Alibaba

Alibaba is the world's largest retailer, and has recently launched a VR store called [Buy+](#). This allows consumers to wander through a VR mall with big name stores like Macy's, Target, and Costco. The stores have inventory that consumers can interact with and purchase.

Additionally, Alibaba has opened a VR research laboratory called the Gnome Magic Lab, which works on VR and AR technologies to assist sellers on Alibaba platforms to build their own 3D product inventories. The long-term goal here is to give any business the tools to create its own 3D inventory, and to set up an e-commerce store in VR.

eBay

eBay teamed up with Australian retailer Myer for what was touted as “[the world’s first VR department store](#).” When users enter the virtual store, several categories of retail items are shown. Users then select an area of interest and browse without leaving the comfort of their home. Discovery and recommendation are a primary part of the experience, as algorithms analyze selection and rejection to identify preferences and predict future actions.

Users select items through a system called “eBay Sight Search.” Users hold their gaze for a couple of seconds, and are offered a more in-depth menu of available actions. Items can be added to the basket or analyzed in a more detailed way. To check out, users remove the headset and return to the eBay app.

Ashley Furniture

[Ashley Furniture VR and AR](#) enables users to create interior layouts and experience living spaces in 3D. “Augmented and virtual reality are essential to our growth and vision for the future,” said Todd Wanek, Ashley’s President and CEO. “Our data shows that a combination of 3D visualization, seeing, touching and feeling actual products, combined with the consultation of our knowledgeable salespeople, will lead to a stand-apart customer experience that is location-flexible.”

To capitalize on the emergent medium, Ashley is working closely with Marxent, a leader in augmented reality and virtual reality for products and spaces. Ashley is utilizing Marxent’s VisualCommerce platform to create and scale their product catalogue and publish new 3D product experiences for VR and AR. Beyond Ashley Furniture, Marxent’s clients include Fortune 500 retailers, builders and manufacturers including American Woodmark, AZEK Building Products and USG.

IKEA VR



IKEA

[IKEA VR](#) enables customers to try out a variety of home furnishing solutions before buying them, ensuring optimal functionality and customer satisfaction. The app is available on the Steam platform, and is capable of room-scale motion tracking so that a user can perform basic tasks like open doors, drawers, and cabinets for the space they are creating. It is also equipped with a teleport function for flexible and quick mobility. The app also features the ability to shrink oneself to child size in order to test whether any of the door frames or counter tops would pose a danger. Likewise, users can enlarge themselves and experience it as 6.4 ft. (195 cm) tall adult.

TRAINING

VR training is “learning by doing.” Flight simulators for training pilots are the most well-known and successful applications of VR, but other sectors are enhancing their training programs through the use of AR and VR.

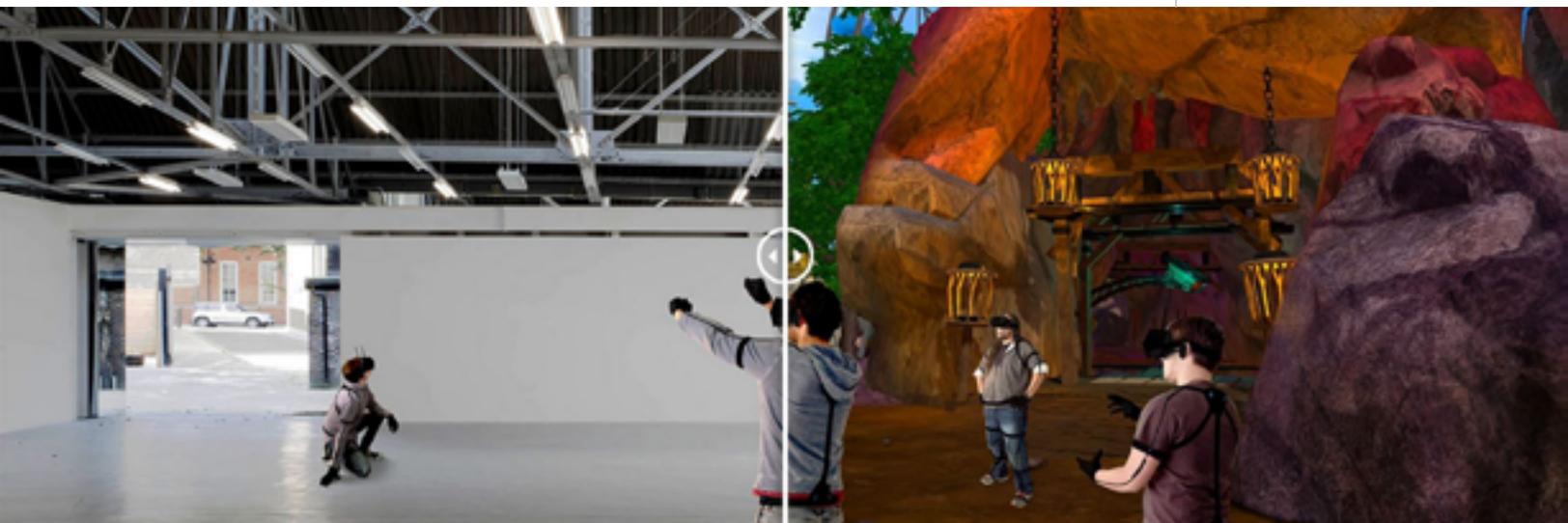
Lockheed Martin

[Lockheed Martin](#) awarded a grant to Brigham Young University to develop training for engineers, teaching them how to replace and repair aerospace and defense units. The system leverages immersive 3D technology from the Unity game engine, to create training environments accessible to engineers from any location in the world. This virtual technology can reduce the costs of training with constantly changing hardware, and significantly reduce the costs of having to transport and house employees during training.

Modal VR

[Modal VR](#), co-founded by Nolan Bushnell (founder of Atari and Chuck E Cheese), is working on a versatile platform that, among several other uses, could help train law enforcement. Police force training is currently simulator heavy, so the ability to cut training costs with a digital environment might revolutionize testing and scenario practice.

MODAL VR



Virtual Heroes

[Virtual Heroes](#) has several programs that gamify training in medical, military, education, and government. One of their more successful programs is called HumanSim. It enables doctors, nurses, and medical personnel to interact with patients in a 3D environment. The simulation enables health care professionals to sharpen their assessment and decision-making skills without risk to patients in realistic, challenging, immersive environments.

Campfire Union

Another example of training simulators available today is [Tower Crane VR, Trainer Edition by Campfire Union](#). This is a multiplayer learning system that allows trainees to come together in a virtual construction site. One user operates the tower crane, while another user acts as signaler from a nearby building, providing both visual and auditory cues via the company's online multiplayer VR technology.

TRAVEL & HOSPITALITY

VR allows consumers to explore locations around the world, helping hotels sell and upsell travel products and accommodations. A technology that enables total immersion, exploration, and sense of presence is ideal for this industry. With VR tours, mass audiences can be reached at once; a travel agent or tour guide no longer needs to serve people one-by-one

About 44% of travel sales and bookings are expected to occur online over the next five years, according to data from [Euromonitor International](#). This is 4x higher than the retail industry (11%) and nearly 5x higher than restaurants and dining (7%). It is clear that prospective guests are using a travel company's digital presence to determine if their hotel is the right pick for their stay.

While mobile apps and social media platforms have become the norm, VR tours have yet to reach critical mass. Offering prospective guests something new and exciting gives participating travel and hospitality companies a significant marketing edge.

ASCAPE

[ASCAPE](#) is a virtual tour app with professional and user-generated 360 content aggregated around travel destinations and experiences.

Jaunt

Jaunt's [Home Turf](#) series transports you to adventure-sport hot spots, with pro athletes guiding you along. "Rock-climb in the Needles, kayak a waterfall in Iceland, or slackline across a canyon in Moab."

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Marriott Hotels

[Marriott is test-driving VRoom Service](#), whereby guests order a headset to watch “VR postcards” of different Marriott locations. They also have 4D experiences of their locations that consumers access through booths they call the “Teleporter station,” which travel to Marriot locations throughout the world. The teleporters have been an extremely popular component of Marriott’s “Travel Brilliantly” campaign.

Qantas Airlines

Australia’s Qantas Airlines partnered with Samsung to create the first in-flight VR experience; strap on a Gear VR headset to take a helicopter tour of the Hamilton Islands, or snorkel off the Great Barrier Reef.

Radisson Hotels

Radisson Hotels reported that hotels offering a VR tour are seeing online [revenue increases of 135%](#) over hotels without one.

Solfar Studios

[Solfar studios has created a VR experience](#) to take you to one of the most unreachable locations on earth: Mt. Everest.

TimeLooper

[TimeLooper](#) is a VR/AR mobile app that is reshaping how we experience history and sightseeing. TimeLooper has recreated and documented historic events at iconic locations across the globe so that when a user physically arrives at one of the historic

sites, they can relive moments that made them historic. There are several sites in London, New York, and Washington D.C., with other sites being added frequently.

When one visits the partner sites around the world, they pick up a headset at the ticket office, and experience the historic moment. To use in AR mode, just skip the headset and align the smartphone against the on-site surroundings to see the site in different time periods.

Thomas Cook

[Thomas Cook](#) offers their own VR app that gives travelers a glimpse of vacation offers, and gives immersive overviews of various resort hotels. [Bloomberg Business](#) reports that VR marketing increased revenue for a Thomas Cook New York tour by 190%.

Virgin Atlantic

[Virgin Atlantic](#) lets potential customers experience an Upper Class flight.

Computer rendered VR refers to the use of a game engine such as Unity, Unreal, or CryEngine, to render—in real-time—a virtual world that can be made interactive thanks to the ability of the system to render changes in lighting, motion, distance, time, etc.

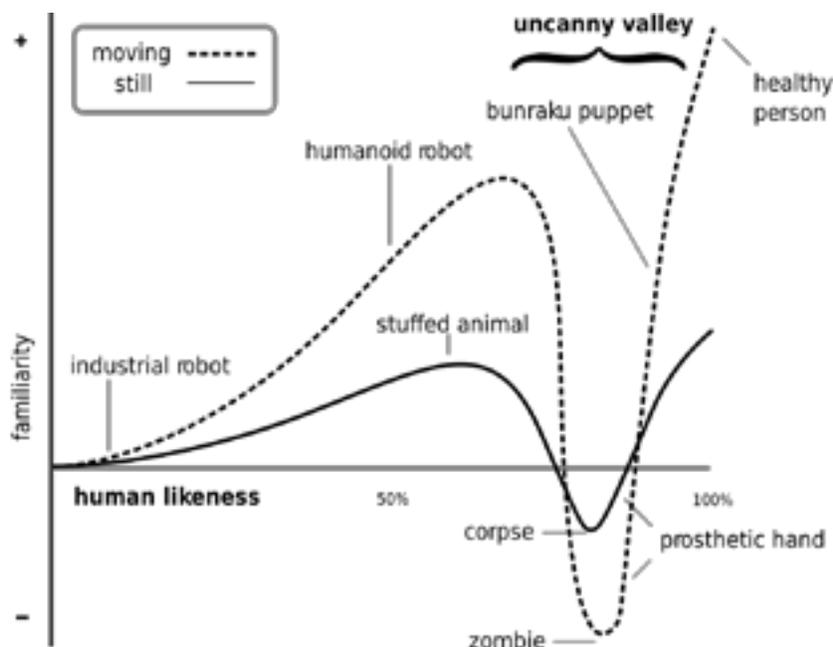
This is not possible with traditional 360 video, or live action VR, which is pre-rendered. As a reference point, one frame of an animated film can take up to 12 hours to be rendered; a game engine renders a frame every 10-15 milliseconds. CG VR can take advantage of the 6 degrees of freedom (DOF) enabled by full body motion tracking. The companies behind the major game engines have realized the potential of their technology to develop VR and AR applications and content, and have already been giving major support to editing tools designed for native VR/AR development.

The main drawback of CG vs live action is the “uncanny valley thesis,” which posits that people find renderings of natural features to be appealing—until they look almost, but not exactly, like the subject they’re mimicking. For example,

“Raw Data”
Survios



it is comfortable for us to watch a cartoon animation of a human. But if that image gets too close to a human, it feels weird, until it reaches exact representation—which it never does. AAA game developers have still not reached the point of quality where character models and video game environments look exactly like they do in life as well.



Sophisticated motion-capture techniques pioneered by big budget films have spurred this area of technological development, allowing natural human movement to be captured and rendered in a virtual space. Now, motion capture technology is evolving to enable full renderings of human bodies into VR, creating extremely detailed models that can be walked around in full 6 DOF, practically bypassing the “uncanny valley”. This is called **volumetric capture** of video and can technically be considered both live action and CG; data points are captured by a camera system. Then, that data is fed into a game engine to be processed and visualized.

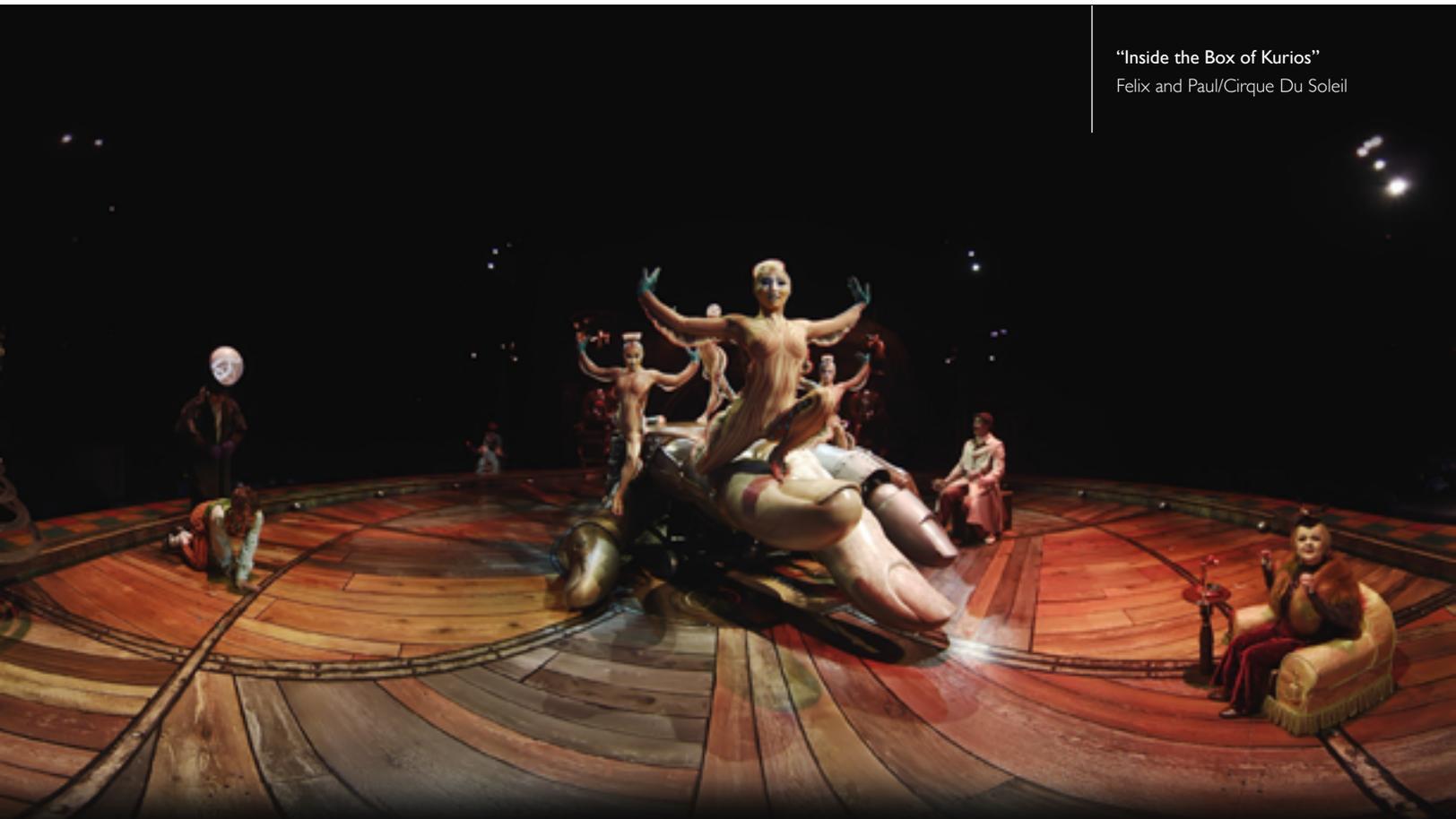
Another step beyond volumetric capture is light field capture, which utilizes a camera system that captures data of all light in a space, and translates that data into a game engine, allowing for the manipulation of individual pixels from the scanned environment to create interactive experiences. This marriage—capturing a real environment and everything in it, and then being able to manipulate it—it is the Holy Grail of VR and AR creation. It will enable the re-creation of our current universe and the generation of completely new ones.

As opposed to computer-generated VR, live action VR refers to the capture of live events into a navigable experience, in which the viewer can explore the physical space of the piece.

In the past, live VR has been subject to limited range of motion, in which users can move their head to explore a space -but can't necessarily move forward to navigate their environment. This is changing as more advanced "stitching" (the editing of VR files to form continuous, seamless files) have begun to add the Z Axis into live experiences. The development of volumetric scene capturing technology will further evolve the capabilities of this medium.

Superior post production process is always essential for making a superior VR product. Tools such as image stabilization are particularly crucial to reducing motion sickness and improving the overall experience.

"Inside the Box of Kurios"
Felix and Paul/Cirque Du Soleil



WebVR enables 360°/VR content to be viewed on mobile, desktop, and in VR headsets through web applications.

WebVR enables 360°/VR content to be viewed on mobile, desktop, and in VR headsets through web applications. A-Frame is the first open source library pioneered by Mozilla for web developers to use for building websites with VR viewing capabilities using as little as one line of HTML code. It eliminates the need for developers to know the complex WebGL 3D API otherwise required to code an experience to life. Other open source libraries have been created since A-Frame including Vizion, PlayCanvas, BabylonJSor, PrimroseVR, Zeovr, and Oculus' own ReactVR. WebVR is currently supported by all major web browsers as well as those compatible with Oculus Rift, HTC Vive, Samsung Gear, and Daydream VR. WebVR will be the fastest way for virtual reality to proliferate throughout society and enable seamless movement throughout experiences.

As aptly explained by Thomas Balouet, cofounder of WebVR-based startup LucidWeb, "You know that feeling you have when you just want to check a cooking recipe on the Internet, and two hours later you're reading an article about Patagonia on Wikipedia? Well, imagine you put on your headset to watch a cool relaxing experience, and 15 minutes later you find yourself talking with friends on top of a mountain or flying over your home town. That's what the Metaverse would be, and this kind of situation would be possible only with deep-linking, one place bringing you to another one related to it, without you having to come back to a common place, or even realizing you're leaving the first place. Only WebVR can enable that."



Both AR and VR (ultimately, mixed reality) will fundamentally evolve the way we connect with each other.

While AR and MR will develop into a holodeck type experience that will allow people to visualize their friends and family with them wherever they are, VR will provide a type of experience derived from what we know today as MMORPGs or massively multiplayer online role playing games, except on a much grander scale and with many more different activities to partake in.

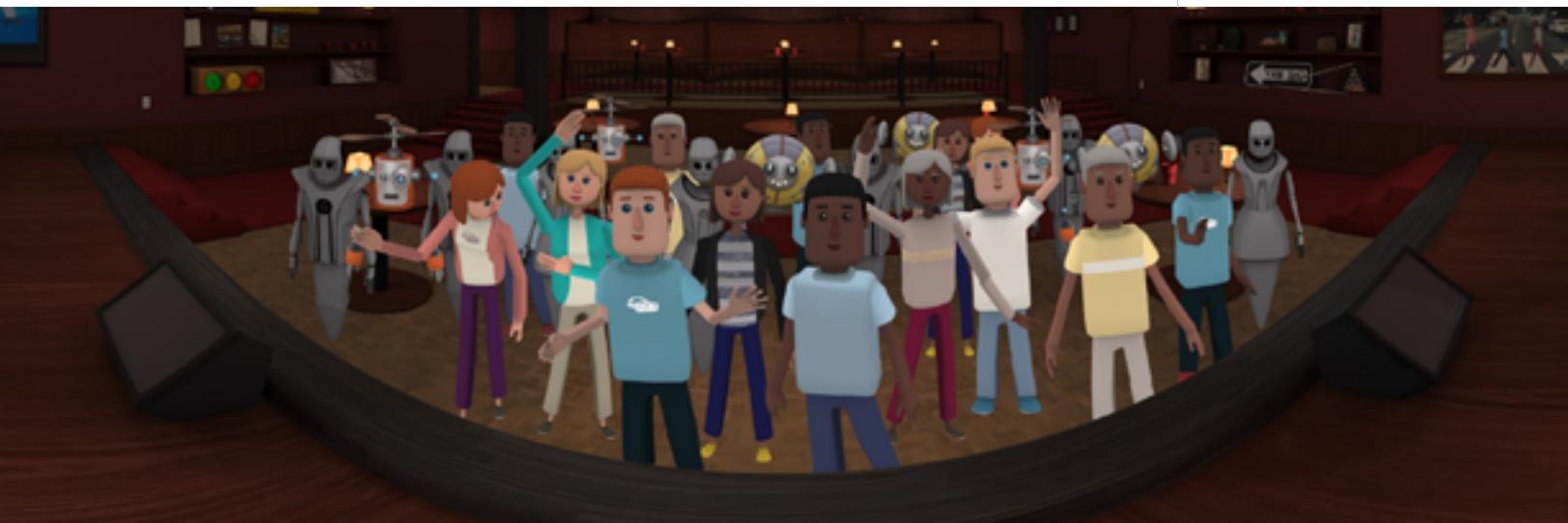
Although certain social spaces in VR will end up being more popular than others, eventually all virtual worlds will be seamlessly navigable. The term for the framework connecting all such virtual space together is called the metaverse.

AltspaceVR

[AltspaceVR](#) was started in 2013 and developed using Unity and A-frame. It works with Rift, Vive, and Daydream and Samsung Gear HMDs. The idea is for Altspace to “live” in WebVR and for anyone to be able to build and drop 3D assets or entire interactive experiences using A-frame, to as many devices as possible.

Altspace has focused on hosting live events to bolster engagement and explore such a possible avenue for monetization, however the company acknowledges that the social VR space is still very much in its infancy. In the next several years the goal is to build an engaging, monetizable, and scalable social ecosystem.

AltspaceVR



Facebook Spaces

[Spaces](#), the first major social VR experience released by Facebook, has been highly anticipated and generally well received. Oculus Rift users can enter a virtual space that they can share with other Rift wearers, as well as with friends via Facebook. 360 videos and movies can be experienced together, and users can create virtual objects in the space and choose from several facial expressions for their avatar to perform (which is created by an algorithm that analyzes your FB photos, and can be customized with accessories). The avatars can even take selfies together with a virtual selfie stick, with the ability to post photos online instantly.

Facebook is slowly but surely realizing its vision of enabling social VR. While the company may not have announced anything as ambitious as Sansar to date, it has a long-term road map for introducing social VR to Facebook users in the most natural and compelling way possible.

High Fidelity

Phillip Rosedale, the founder of Second Life, left Linden Lab in 2009, several years after user growth stagnated at around one million. His own spiritual successor is based on his vision to democratize the creation and sharing of VR experiences. [High Fidelity](#) can be downloaded by anyone with a PC capable of running it and allow anyone to essentially host their own VR domain and allow anyone to create virtual experiences with basic coding skills. A sandbox creation toolkit enables those with no coding skills to create and share content. Rosedale still collaborates consistently with Linden Lab in the development of Sansar, seeing Sansar and Fidelity as analogous projects with differing approaches toward ultimately creating social connection with VR.

Project Sansar

The company behind Sansar called [Linden Lab](#) also created arguably the deepest virtual online social experience to date called Second Life. Launched in 2003, the virtual world could be accessed by any baseline computer with internet, allowing users to create their own avatars and communicate with each other through text or voice chat while exploring the virtual world.

Second Life had its own economy and currency (the Linden dollar L\$, which could be exchanged for real dollars) as well as its own content creation toolset. Users developed communities and events in Second Life that touched on everything from [politics](#) and [education](#) to [religion](#) and [relationships](#).

360 videos and movies can be experienced together, and users can create virtual objects in the space and choose from several facial expressions for their avatar to perform (which is created by an algorithm that analyzes your FB photos, and can be customized with accessories)

Building on the success of Second Life (which is still actively supported and will be in the foreseeable future), Project Sansar will launch in open beta sometime in summer 2017 and will start to actively expand the interactivity of the virtual space as more users join the platform. Linden Lab will monetize by taking a small percentage from all transactions made by users. Support is planned not only for Oculus Rift and Vive but also PCs (in 2D mode) and eventually mobile HMDs.

Pluto VR

Instead of attempting to create a social virtual world and entice users to interact with each other in it, [Pluto VR](#) takes a completely different approach to social VR by enabling social interaction across current VR experiences that are already available. Users can join their friends and watch as they scroll through experiences on their headsets while they are inside the virtual space represented as avatars. The level of interaction is currently limited to talking and visual gestures with the avatars, and Pluto is developing additional features to enable the sharing of other content.

THEME PARKS

Global Malaysia VR

[Global Malaysia VR Theme Park](#) is being developed by gaming company EXA Global with Mediasoft as a content partner, in Puchong Malaysia. The park will start off with three wide open rooms where groups of 4 roam freely, fending off incoming waves of attackers while also being able to upgrade weapons and armor in a game similar to Zero Latency. The experience is expected to cost roughly \$18 and last about one hour.

SPACES

[SPACES](#) was founded by DreamWorks vets Brad Herman and Shiraz Akmal in summer 2016, as a \$30M joint venture between SPACES and Songcheng Performance Development Co. to bring mixed and virtual reality to existing shows and rides at Songcheng theme parks. Spaces will also be working to enhance Songcheng's existing live streaming site, 6Rooms, which attracts 33 million users a month streaming their own shows and creating more than 50,000 live broadcast hours each day.



The Void

[The Void](#) is a VR theme park based in Lindon, Utah with additional locations in New York and Dubai. Essentially a high-tech maze in a warehouse kitted with movement and pressure sensors, participants put on a wireless backpack with a tethered headset and plastic gun, and explore the virtual experience with friends. Utilizing a layering of real-time interactive environments, and blending the real world with the digital—participants are placed into “Hyper-Reality” experiences. The first major experience developed for The Void is the Ghostbusters Dimension: VR Experience, which launched at The Void’s NY location in Madame Tussauds Wax Museum. The feedback from those who’ve tried it has been overwhelmingly exciting. Their current revenue model is charging \$20 to upgrade your Wax Museum ticket for an additional 15-minute experience. The Void plans to open an additional 20 locations in 2017 and China’s Shanda Group has invested \$350 million into The Void to bring VR theme parks to China, which should help accelerate The Void’s goal of opening [230 locations by 2020](#).

Zero Latency

[Zero Latency](#) is another high-profile VR theme park based in Melbourne, Australia, with locations in Orlando, Florida and Tokyo, Japan. The main consumer experience revolves around a four-person shooter in which players defend a battleground from zombies. The company’s plan is to provide a “business in a box” revenue partnership model for any international partners to set up and operate. They consider this franchise model to be most efficient, rather than building and operating its own virtual reality experience centers.

Zero Latency helps with the design and installation of the attraction, supplying both ongoing support and content. They utilize online tools from system diagnostics to a booking engine, providing a complete turnkey package. Other than multiplayer gaming, the Zero Latency space has also been used for other industry applications such as 3D real estate visualizations.

The Melbourne space is 400 square meters of space, perceived to be much bigger due to redirected walking. Tickets are \$88 per person. A standard ticket will get you approximately 45 minutes in-game, depending on how fast you move through it. Wireless motion tracking with 128 cameras equips each round for up to 6 players. In the near future, they are rolling out customized HMD’s from [Sensics](#) using the [OSVR](#) platform, as well as new controllers.



Viveland
HTC

VRCADES

IMAX

[IMAX VR](#) has opened their first experiential VR center in Los Angeles, charging \$10 for 10-15 minute play-throughs of popular SteamVR games on the HTC Vive and StarVR headsets. IMAX has recently announced a partnership with Warner Bros. to create VR experiences for their superhero movie IPs and bring them to the VR center.

Modal VR

[Modal VR](#) has developed a system that lets up to 10 users explore virtual reality in large spaces—as big as 900,000 square feet, with durable, untethered headsets. The company has already developed three games for their system and is working with developers to make more games for its platform. They are also finding partners to develop enterprise applications for the system such as for real estate and construction/architecture visualizations, immersive educational programs, and training simulators for jobs of all types. The system is being developed to be semi-portable, in order to empower clients to take it mobile and set it up in various locations as necessary.

Two Bit Circus

[Two Bit Circus](#) is building the next generation of micro-amusement parks, recently announcing a 30,000 square foot space in Los Angeles, which will house all of their experiences. Two Bit Circus also has traveling programs, bringing immersive entrainment to you. One of their most popular in this category is [STEAM carnival](#), which gamifies science, technology, engineering, art, and math. Amongst several other exciting projects, they have a proprietary haptic turret motion platform that enables fighter-pilot style games.

Viveport Arcade

[Viveport Arcade](#) is HTC's proprietary content management and distribution platform for location-based entertainment. It serves both operators and developers by identifying, securing, and safely distributing content, as well as managing payments through a centralized system. The operator gets a library of VR content they can use, while HTC tracks usage and playtime directly, and shares that with the arcade operator.

Commercial arcade operators can download the software to their venues, allowing them access to a library of legally acquired content, which they can configure across their Vive stations via a centralized host client tool. Operators and developers then split the revenue. The software is built to serve as a turnkey method for developers to easily distribute and monetize their content to physical locations like arcades, Internet cafes, theaters, and shopping malls around the world, while giving operators an end-to-end system to discover and deliver great VR content to their customers.

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Though less powerful than premium HMDs, mobile VR lowers the barrier to adoption by an order of magnitude. The evolution of mobile VR/AR will be spurred by the enormity of the global smartphone market, as manufacturers and service providers look for ways to drive adoption.

Google Cardboard

Since 2014, Google has distributed over 10 million [Cardboards](#). “Cardboard” refers to smartphone holders that mount over a mobile phone, similar to a pair of binoculars. Cardboard is smartphone agnostic; the user just downloads an app like Within or Jaunt, or can browse the growing selection of YouTube360. Cardboard enables the most basic VR experiences, and at a price point from free to \$15, it is powering the mass adoption of VR in the near-term. Most people’s first VR experience will come through a Cardboard.

Google Daydream

Composed of both hardware and software, [Daydream](#) is the higher-tech successor to Google Cardboard. The device is a mobile VR system compatible with the generation of Android smartphones running Android Nougat. While Cardboard works with almost any smartphone, Daydream will be compatible with exclusive phones:

Daydream VR
Google



Google Pixel, Motorola Moto Z, Huawei Mate 9 Pro, ZTE Axon 7, ASUS Zen Phone AR, with more Daydream ready phones coming this year.

The components of these phones offer a smoother, lower-latency experience than would be possible with a simple software update to alternative smartphones. Daydream retails for \$79.

Google Tango

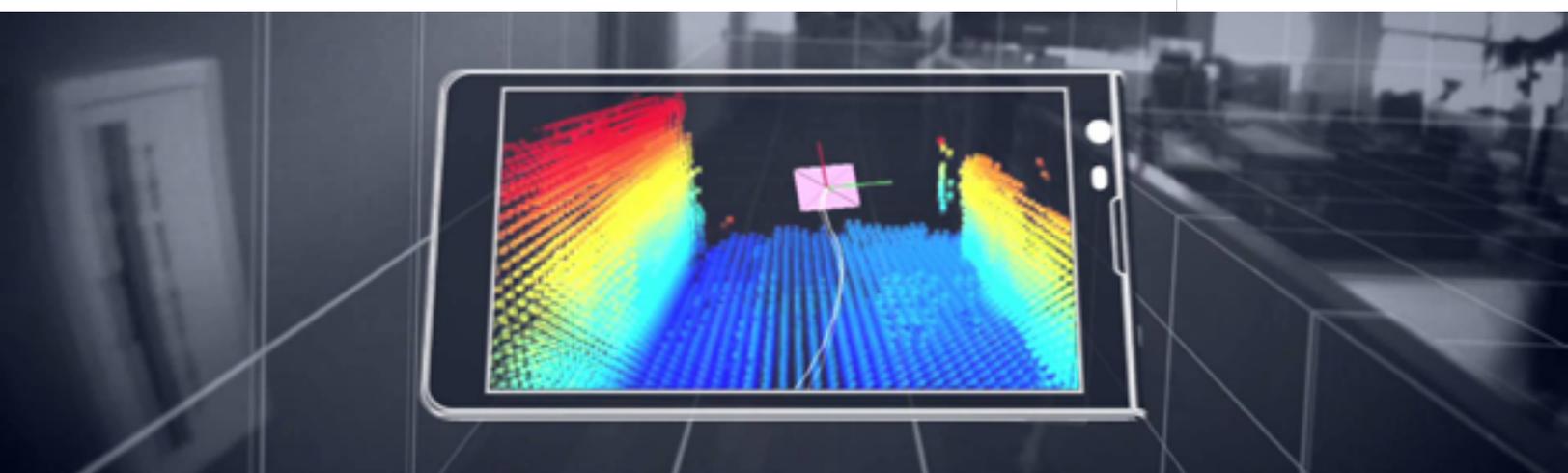
[Google Tango](#) is an AR computing platform which enables smartphones and tablets to detect their relative position through the use of 3D cameras and odometry. It brings human-like vision to your mobile devices, which can be used for a wide variety of applications such as AR, MR, indoor navigation, physical space measurement, and 3D scanning. Lenovo's Phab2Pro was the first Tango-powered device brought to market in 2016. In January 2017, Asus launched ZenForce AR at CES. Since its release, developers have built 3D scanning apps with Tango. Among them are:

1. RTAB-map
2. Evryway
3. Open Constructor
4. Simple scanner
5. Google Constructor
6. Matterport
7. Voxxlr

Intel RealSense

[RealSense](#) supplies 3D depth mapping. The technology uses various sensing technologies to achieve depth perception,

Tango
Google



3D imaging, interior mapping, and feature tracking. In conjunction with [Movidius](#), Intel is pushing the boundaries of computing innovation, to supply VR, AR, and MR developers with streamlined 3D scanning and a simpler process for capturing 3D models. Intel RealSense is certainly powering the next wave of immersive media way beyond smartphones.

Samsung Gear VR

[Samsung's Gear VR](#) provides users a high-quality VR experience without the high cost of specialized, much more powerful alternatives. Samsung has strategically positioned themselves at the forefront of mobile VR, using their massive resources to dominate distribution and attract new customers by keeping hardware compatibility exclusive. They sold a total of [4.51 million units in 2016](#), outpacing every competitor.

Samsung has released an updated model of the Gear VR headset to accommodate its new Galaxy S8 and S8 Plus phones. A main difference in the upgraded model is the add-on of a wireless controller, which allows increased interactivity, and a smoother experience. The new model and controller are backward-compatible with the S6 and S7, and the controller can be purchased separately as an add-on to a consumer's older Gear VR. The price is \$130 for the new model of the Gear VR, including the controller.

Features include built-in sensors and smartphone-compatible controls, as well as focal and latency adjustment, and even a cooling fan. Facebook's Oculus is providing content support by working with developers and growing the Oculus Store. Here, the user can access all VR content for the headset, including Oculus 360 and Cinema. Facebook is currently focused on developing social features with Oculus, including avatars and other multiplayer functionalities. This gives the Gear VR headset an immense long-term advantage over its competitors.



Gear VR
Samsung

HTC Vive

The [HTC Vive](#) was developed by Valve and HTC as a push for creation of VR content and wider-spread adoption of VR. It was released in April 2016, its 15,000 pre-orders selling out in 10 minutes. Currently the cost is \$800 for the HMD, two motion controllers, and SteamVR tracking system. These, in tandem with the Vive's front facing camera, let the headset and controllers track their exact location and movement. For an additional \$100, the [Vive Tracker](#) can attach to any real-world object, bringing positional tracking to it.

HTC is looking for alternate forms of consumer adoption rather than solely via retail, and has partnered with one of China's largest internet cafe software provider ShunWang Technology. This is smart considering that the relatively short length of current VR content lends itself well to the massively successful business model of charging for play time by the minute in China, as well as the fact that ShunWang claims to reach over 100 million people in more than 100,000 cafes, currently controlling a market share of around 70%. For ten minutes, users pay anywhere from \$2-\$5.

In October 2016, HTC announced a partnership with InterContinental Hotels Group (IHG) to bring the HTC Vive to sites in Chinese cities like Beijing, Shanghai, and Sanya. Guests can head to a 'Vive Zone' or be in their rooms to sample the headset with a selection of games and experiences through SteamVR and Viveport. That

HTC Vive (left), Oculus Rift (middle), Sony PSVR (right)



same month, HTC opened its third “Vive VR Café” in Shenzhen, China and have confirmed hundreds more to come in 2017 worldwide. They have also suggested franchising opportunities for these cafes.

LG/Valve Developers Kit

Introduced at GDC 2017, LG is Valve’s second HMD partner. The LG/Valve DK will be similar to the Vive that Valve created with HTC. It will utilize the SteamVR platform, and Valve’s royalty-free [SteamVR 3D tracking system](#). This tracking system lets the device know, in real-time, where it is within a room.

The HMD will have a 3.64-inch diagonal display, 1440 x 1280 resolution per eye, refresh rate of 90Hz, and 110° field of view. The big new feature: the goggles flip up without needing to remove the whole headset. This will prove particularly useful for developers, who constantly need to go in and out of VR when developing content. The projected price point is \$700-800.

Microsoft Windows 10 VR HMDs

Microsoft is taking VR/MR extremely seriously. Expect to see them make big waves very soon. [Microsoft has partnered](#) with Acer, Lenovo, Asus, Dell, and HP to create a VR/MR HMDs for PC and their XBOX console. Microsoft is making VR/MR a priority for its Project Scorpio, the codename for the next Xbox One model, which is capable of true 4K gaming, high-end virtual reality, and HDR content. Acer is the first model ready to ship, as its HMD, Windows 10 Insider, and SDK are all available to developers now. The Acer headset comes equipped with two high-resolution liquid crystal, 1440 x 1400 displays and a 90 Hz refresh rate.

Rather than having an external camera read the position of LEDs on your head, Microsoft HMDs include sensors that are built directly into the headset. This is called “inside-out” tracking as opposed to “outside-in,” and enables 6 degrees of freedom. These internal sensors detect how the wearer is moving and registers that to match their in-VR position. This removes the need for a dedicated VR room: users can walk around normally. These headsets will be tethered, but will not require as high powered computers as do the Vive or Rift.

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Microsoft also partnered with the Chinese company 3Glasses. Their headset, dubbed [Blubur S1](#), will be a higher-end system, featuring 2880 x 1440 pixels, and a refresh rate of 120Hz. Priced at \$449, the Bulbur S1 features 24 infrared surface LEDs to enable precise positional tracking with the supplied external camera as part of the 3Wand Suite. 3Glasses also has its own store called VR Show, including several VR titles and support for SteamVR via a plugin.

Microsoft and Intel are also collaborating ON “[Project Evo](#),” an initiative to merge their diverse PC offerings to deliver systems that will support far-field speech communications. Users will be able to speak to their connected PCs from across a room. Also included will be improvements to Windows Hello biometric identification (which currently includes fingerprint, iris, and facial recognition); security intelligence from both Microsoft and Intel; gaming innovations like 4K displays with High Dynamic Range, Wide Color Gamut (WCG), spatial audio, and the ability to broadcast games and e-sports; improved mixed-reality experiences through affordable PCs and head-mounted displays (HMDs).

Oculus Rift

Oculus' \$2B acquisition by Facebook rocketed it to stardom, and quickly became the face of high-end VR. The [Oculus Rift](#) was the first headset to provide developers with software/content creation kits (SDKs), and active support of third-party content development by sharing technical upgrades and best practices, and in some cases, even financing development.

Rift comes bundled with a positional tracking sensor and Xbox controller. Oculus Touch is being offered for an additional \$200, and functions as both a gamepad and motion sensor. It tracks hand movements to allow users to more fully interact with their environment, which provides more intuitive control than a standard gamepad. Facebook and Oculus are working to make the Oculus Store the leading destination for VR content, and the leader in marketing virtual experiences. Oculus demoed the HMD in select retail locations for about 9 months in 2016. In February 2017, Best Buy announced they would remove half of their Oculus demo stations.

The strong visibility of the Oculus brand and the deep financial resources of Facebook provided Oculus with an opening advantage in the marketing, production and distribution of Rift.

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See [here](#) for a detailed spec comparison between VIVE and Oculus.

Oculus Santa Cruz

Beyond the Rift, Oculus has announced its self-contained [Santa Cruz](#) HMD. Simultaneous Localization and Mapping (SLAM) technology enables the headset to use four built-in cameras to sense the environment, and mirror that movement in the virtual world. According to Facebook CTO Mike Schroepfer: "This headset doesn't require a cellphone. It doesn't require a PC. No special hardware in your room. You just grab the unit, put it on your head [and] you're instantly in VR."

PlayStation VR

[PSVR](#) has sold over 915,000 units between October 2016 and February 2017, making it the best-selling high-end HMD to date. Having been on the market for roughly 4-5 months, these numbers are [surprisingly high](#). As a reference point, the original iPhone sold 1.4 million units its first 3 months on the market, and it is considered one of the most successful tech products of all time. Sony's internal goal was to sell one million units in its first six months, by mid-April, and is on track to surpass that forecast. Overall, this sales figure is a very positive sign for the entire industry.

[PSVR](#) has sold over **915,000** units between October 2016 and February 2017, making it the best-selling high-end HMD to date.

The success of PSVR is due to the previous install base of PS4 (53.4 million PS4s worldwide), who could buy a VR system for \$400, instead of buying an expensive computer plus a \$600-\$800 Oculus Rift or HTC Vive.

[PSVR comes with](#) a 5.7 inch OLED display panel, 1920×1080 resolution, a refresh rate of up to 120hz, and a 100° field of view. The LEDs around the PlayStation VR headset, on the DualShock 4 wireless controller, and the PlayStation Move motion controller are tracked by the PlayStation Camera, providing precise capture of natural movement in virtual space.

Qualcomm Snapdragon 835 VR DK

Qualcomm recently introduced its development kit for its [Snapdragon 835](#) mobile platform. This dev kit will give developers access to an HMD that is built with the Snapdragon 835 mobile platform.

“With this new VRDK, we’re providing virtual reality application developers with advanced tools and technologies to accelerate a new generation of VR games, 360-degree VR videos and a variety of interactive education, enterprise, healthcare and entertainment applications,” said Cristiano Amon, executive vice president, Qualcomm Technologies, Inc., and president, QCT. “We see great potential for the exciting new experiences made possible by truly mobile, untethered virtual reality that’s always connected to the internet, and we’re excited to help mobile VR developers more efficiently deliver compelling and high-quality experiences on upcoming Snapdragon 835 VR-capable products.”

The HMD dev kit consists of four megapixel (2560x1440) WQHD AMOLED display (two megapixels per eye), six degrees of freedom, and eye tracking. For a more detailed look into the Qualcomm Snapdragon 835 VR DK, [click here](#).



Snapdragon 835 VR Dev Kit
Qualcomm

StarVR

The [StarVR](#) HMD is a product of Starbreeze and Acer. They recently partnered with IMAX to offer a location based entertainment zone. What differentiates this headset is that it has a 210 (horizontal) x 130 (vertical) degrees FOV compared to most other HMDs that are roughly 110 x 100. Further, it features 5K resolution via dual 5.5" quad HD display, 6 degrees of freedom via outside-in tracking, and retinal tracking for foveated rendering. This technique improves rendering performance, by reducing the image quality in the peripheral vision. The image resolution, or specifically the amount of detail, varies across the image according to one or more “fixation points.” A fixation point indicates the highest resolution region of the image and corresponds to the center of the eye’s retina, the fovea. Thus, foveated rendering will reduce the rendering workload.

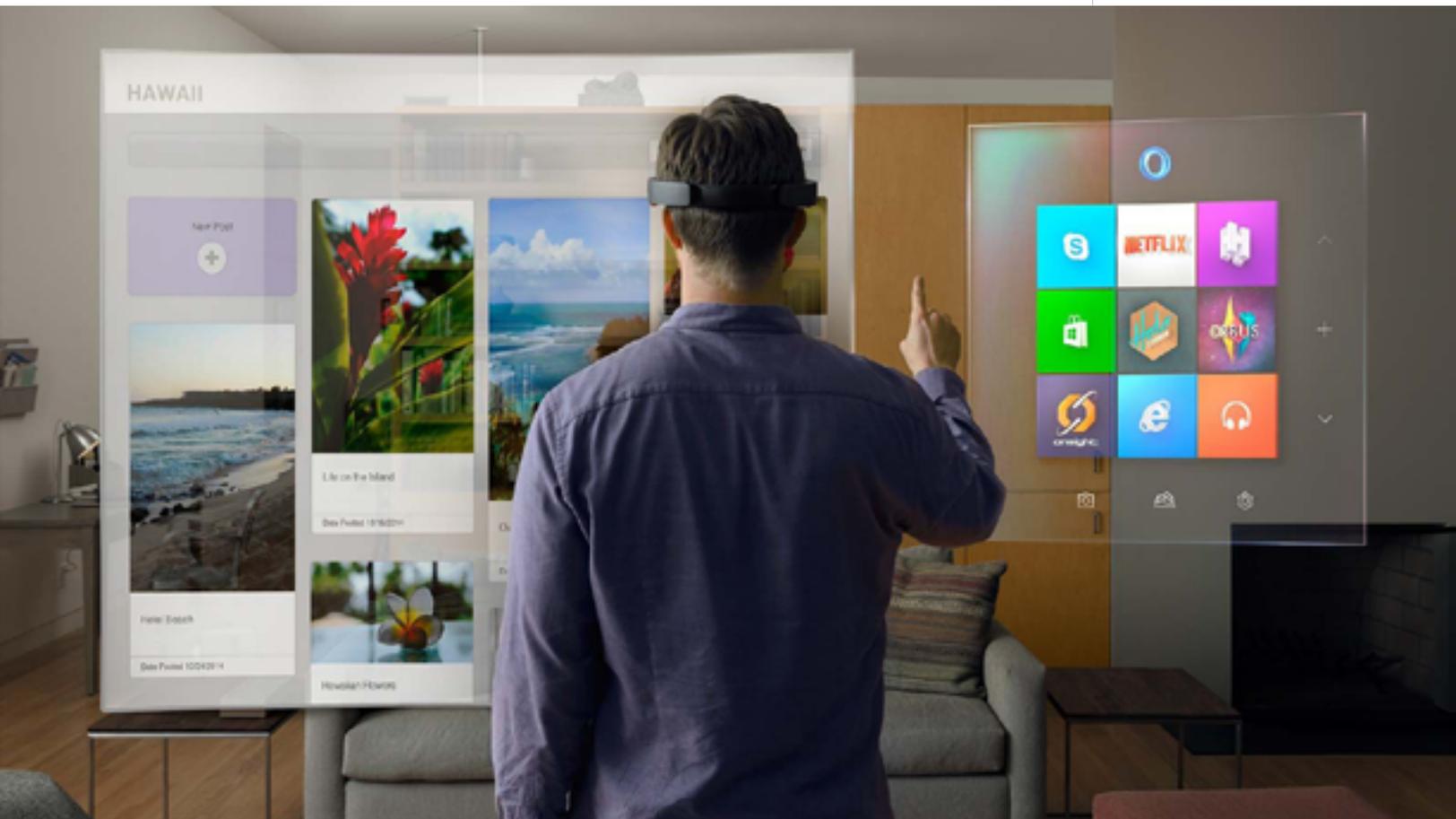
AR/MR HEAD MOUNTED DISPLAYS (HMDS)



AR greatest strength is its inherent difference from VR. Whereas VR blocks out the world around it and is generally an isolated experience, AR adds digital overlays to real-world experience.

It is a medium that lends itself entirely to multi-tasking. AR HMDs empower users to accomplish tasks in the virtual world, without being fully separated from the physical world. This technology has huge potential to transform the utility of everyday life. Soon, people will be able to do anything they do on a computer or smartphone without needing to check their device. Users of AR can access emails, documents and websites directly from their field of vision, and visit historical landmarks to see what they looked like in the past.

HoloLens
Microsoft



DAQRI

[DAQRI](#) targets AR as a tool for corporations to use in factories, operating rooms, and many other industries. They currently have three main products: the DAQRI Smart Helmet, the DAQRI Smart Glasses, and the DAQRI Smart HUD.

The DAQRI Smart Helmet is their premier AR product for the working world. It provides data visualization, guided work instructions, team assistance, and more directly onto the lens, helping increase worker safety and efficiency. The Smart Helmet is powered by Intel's 6th generation m7 processor. It also features a high speed, wide-angled tracking camera and an Intel Realsense LR200 depth sensor. DAQRI also integrated a thermal camera that offers persistent passive thermal monitoring of industrial equipment.

The DAQRI Smart Glasses contain very similar features to the DAQRI Smart Helmet, but in a much smaller and lightweight design. The glasses feature a wireless compute pack that distributes the weight of the headset.

Lastly, the DAQRI Smart HUD is an AR heads up display for automobiles. The technology projects digital information onto the vehicle's windshield, and is currently used in over 150,000 cars.

Smart Helmet
Daqri



Intel's Project Alloy

[Intel's Project Alloy](#) is a self-contained headset that uses Intel's RealSense depth sensors to analyze the environment and provide motion tracking similar to Microsoft's "inside-out" system. The headset features similar 1080p displays and 90 fps and a battery that Intel states will last for "hours".

Unlike the Vive and Rift, Intel's headset does not require being tethered to a computer. Also, Intel's RealSense depth sensors add a new element to virtual reality experiences that the Vive and Rift lack, making it a closer to a mixed reality headset. The sensors can create a 3D representation of the world in front of it. For example, if a user is about to run into a coffee table, the headset creates a virtual representation of the table, preventing a sharp edge to the shins. Further, this technology allows the objects to be incorporated into the VR experience. In the VR experience, the coffee table or chair can be simulated to an object of similar size and space.

Lastly, the RealSense technology also identifies both other people and a user's own body to incorporate into the experience. This helps make the experience even more immersive. Intel plans to partner with headset manufacturers to implement the technology into future hardware. Headsets using the technology are expected to be around \$1,000.

Magic Leap

[Magic Leap](#) is one of the more mysterious companies in the industry. With nearly \$1.4B in funding and a \$4.5B valuation, Magic Leap is considered an industry leader—yet they have no product on the marketplace. Although most of their developmental secrets are under wraps, the company is working on a technology that beams photons directly into a wearer's retina. Magic Leap developed a silicon light-field chip that CEO Rony Abovitz describes as a "three dimensional wave... component that has very small structures in it, and they manage the flow of photons that ultimately create a digital light field signal."

To help generate buzz for their new technology with immersive content, Magic Leap has joined forces with WETA Workshop, Peter Jackson's New Zealand-based special effects workshop.

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Meta 2

The [Meta 2](#) development kit is available now for \$949 and uses a similar technology to the HoloLens that projects digital images onto the glass headwear. The Meta 2's front-facing depth sensors have a 270-degree field of vision that enables the digital projected images to appear as if they are part of the real world. These sensors also track hand movements, allowing users to interact with the projected images.

With a 90° field of view, the Meta 2 has nearly double that of the HoloLens, however, the Meta requires a PC connection to operate. The company plans to create untethered headsets by the end of next year.

Meta 2
Meta



Microsoft HoloLens

[Microsoft HoloLens](#) is a self-contained AR headset powered by Windows 10. The device is one of the first to feature an “inside-out tracking system”, meaning that it does not depend on external sensors to track the user and the surrounding world. Using a number of cameras and depth sensors, the device projects images onto the lenses that appear as a part of the real world. The headset is powered by Microsoft's custom build Holographic Processing Unit, and lasts about 2-3 hours of active use. The HoloLens development kit is priced around \$3,000.

ODG

Earlier this year, award-winning [Osterhout Design Group](#) (ODG) announced two new models to their R-series smartglasses: the R8 and R9. The sleek glasses feature Qualcomm's new Snapdragon 835 8-core processor. The \$1,000 R8 is aimed at consumers and features 720p resolution, dual 1080p stereo cameras, and a 40-degree field of view. The \$1,800 R9 is targeted more towards developers and features 1080p resolution, a 13MP front facing camera (4K at 60 FPS to 1080p at 120 FPS), and a 50-degree field of view. The glasses are controlled using a smartphone or Bluetooth accessories.

Vrvana Totem

[Vrvana Totem](#) developed a wireless headset that can seamlessly display both Mixed Reality and VR, which they call the "Matrix Mode". The headset features a 1440p display, a higher resolution than both the Oculus and the HTC's offering, and the refractive aspherical lens combo produces a field of view of 120-degrees. Vrvana Totem has not released the product for developers yet, and there is no word on pricing.

Zappar

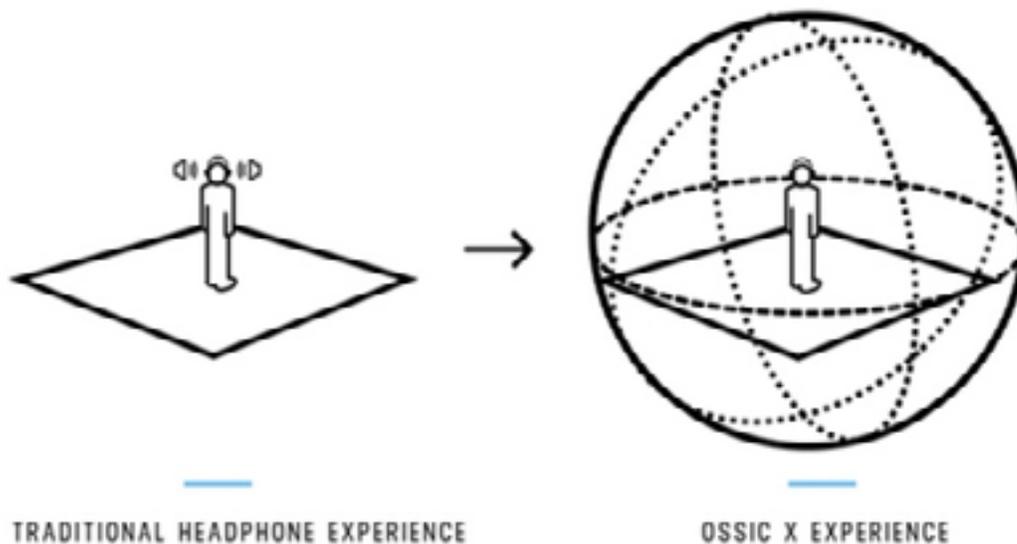
[Zappar](#) is working on a product similar to Google Cardboard, but for AR. Using your cellphone, the cardboard headset provides an affordable way to experience Augmented Reality. The AR experience is powered by Zappar's smartphone app and uses the phone's camera to augment objects into a user's surroundings. Zappar developed markers to put on surfaces around a room to help the app understand depth better. Zappar hopes to sell this bundled experience for as little as \$30.

Spatial audio is essential for immersive experiences. Creating believable 3D audio can be more difficult than creating the visual environment. The truest form of 3D audio can be captured through either binaural or ambisonic recording.

An ambisonic microphone is essentially an array of several small microphones pointing in different directions, making up 360°, while a binaural microphone has two microphones on each side, simulating a human head with two ears.

To match the environmental objects with their corresponding auditory cues in the edit bay, an object-based audio technique must be used, and is the next evolution in audio mixing and recording.

Object-based audio holds these audio objects as individual assets, and allows each asset to contain metadata describing where and how it should play in a three-dimensional space. Previously, surround sound mixing was limited by recording and then mixing audio into certain channels, be it 5.1, 7.1, etc. Essentially, object-based audio simulates sounds in a 3D environment exactly the way the artist intended.



Object-based audio enables sound engineers to give individual objects their own discrete audio “mix” with spatial information, and even enables new height channels to make sounds seem overhead. As an example, a voice heard above a person can cue them to look up, in which case the spatial positioning of the voice’s source travels from above to the front of the person. Listeners can perceive sound elements in the front, behind, from above or below and be truly immersed in any virtual environment, with a stunning level of reality that creates a true sense of presence.

In VR, it is critical that sonic perspective of an object in space is preserved, or the illusion of VR crumbles. Accurate sonic cues are essential so that users know where to explore and focus, and can follow the storyline.

Ultimately, when each sonic source is encoded into its own discrete channel within in the soundtrack, the experience becomes more interactive and infinitely more believable.

Dolby

[Dolby Atmos](#) for mobile devices takes the renowned “cinema sound,” and puts it in built-in speakers and headphones. The effects are stunning, rendering audio that seems to flow all around you, including overhead. Dolby’s object based Atmos solution is very comparable to DTS:X.

It provides crisper dialogue, a more enveloping field of sound, greater subtlety and nuance, maximized loudness without distortion, and consistent playback volume for a wide variety of content.

Dolby Atmos has the potential to revolutionize the sound of music, games, and television shows, and is enabled in the latest Lenovo and Amazon mobile devices. It functions thru any pair of headphones or, to a slightly lesser extent, built-in stereo speakers.

DTS

DTS has developed an object-based audio solution called [DTS:X](#), and complementary DTS Headphone:X technology, which simulate surround sound from 11 discrete sources. Headphones equipped with this technology are like “surround sound to go,” and present the most immersive and accurate sonic space possible. DTS:X is built atop MDA (Multi Dimensional Audio), an open platform for object-based audio that DTS has made available to content makers license fee-free.

Fraunhofer

Fraunhofer's [Cingo](#) offers quite a different solution, making use of head-tracking to advance the entertainment experience on headphones. Cingo is available from Fraunhofer as a product-ready software implementation for mobile device manufacturers, chip set vendors and providers of multimedia services. Cingo supports rendering of 3D audio content with formats like DTS:X or Atmos, which add a height dimension to the sound image, such as 9.1, 11.1. Cingo also utilizes a special equalization feature to compensate for the lack of bass usually encountered with smartphones and tablets, as well as loudness optimization to deliver a natural and clear sound even in noisy of environments. Both features are implemented to prevent unpleasant frequencies, distortions, and clipping, particularly advantageous for content that is very soft or of high dynamic range.

Cingo is enabled on Google's Nexus and Pixel; LG's 360 VR; Alcatel/TCL Communication's VISION VR; and Samsung Gear VR devices.

Dysonics

Dysonics has a unique VR solution called [Rondo360](#). The RondoMic, an ultra-high fidelity 360° mic array, captures sound environments with incredible accuracy and enables live broadcasting in a native 360° binaural format. Rondo360 integrates with all major DAWs and workflows to yield 3D audio. Moreover, regardless of your recording setup, you can leverage the Rondo360's intuitive spatial mixing tools and real-time motion-tracked 360° previewing without disrupting your post production workflow.

Dysonics provides 360 video players with native support for their run-time audio engine for stereo, 5.1, Ambisonics, and Motion-Tracked Binaural (MTB) rendering, along with live streaming support. They also provide an SDK for custom integration into iOS, Android, OSX, & Windows apps.

OSSIC

[OSSIC X](#) headphones offer high-quality and individually-tailored 3D audio. They calibrate to an individual's head by calculating their position in space, head size, and ear shape. It also comes fully integrated with head tracking, a multi-driver array (which directs sound to the correct portion of the ear), a built-in microphone, USB + AUX connection,

and a 10/hr. Battery Life. OSSIC X supports stereo, 5.1, 7.1, and beyond. The latest iteration of the headphones is available for preorder for \$299, and will retail at \$499 thereafter.

VisiSonics

[RealSpace3D](#) is VisiSonic's 3D audio solution that leverages their proprietary algorithms and hardware, which is being incorporated in gaming engines. The RealSpace 3D Gaming Engine enables game and VR designers to create extremely immersive audio, while being efficient enough to work with minimal CPU needs. Further, the RealSpace 3D AfterEffects Engine allows users to mix a 3D audio scene offline via a VST plug-in architecture. A native library and Unity plugin are also available.

Sennheiser

Sennheiser's AMBEO VR Mic is an ambisonic microphone that allows you to capture three dimensions of sound from a single point. This results in a fully spherical sound to complement immersive content. Sennheiser has also developed a comprehensive product package including: A-B encoder software that works as a plugin, which seamlessly integrates with any post production.

According to Sennheiser, The [AMBEO VR Mic](#) "delivers A-format, a raw 4-channel output that has to be converted into a new set of 4 channels, the Ambisonics B-format. This is done by the specifically designed Sennheiser AMBEO A-B format converter plugin, which is available as free download for VST, AU, and AAX format for your preferred Digital Audio Workstation for both PC and Mac. B-format is a W, X, Y, Z representation of the sound field around the microphone. W being the sum of all 4 capsules, whereas X, Y and Z are three virtual bi-directional microphone patterns representing front/back, left/right and up/down. Thus, any direction from the microphone can be auditioned by the listener during playback of Ambisonics B."

THX

The [THX AAA chip](#) is an ASIC chip that's being made in partnership with Triad Semiconductor, a company who also worked with Valve to create constituents of the HTC Vive's Lighthouse tracking technology. THX claims that THX AAA offers "the world's lowest levels of distortion and noise," along with "incredibly low power consumption."



Amebo VR Mic
Sennheiser

Haptic technology recreates the sense of touch by applying forces, vibrations, or motions to a user.

HAPTIC SUITS

We are all familiar with haptic feedback from vibrating calls and SMS alerts. Advanced application of haptic feedback using electro-magnetic stimulation (EMS) or other technology such as sound waves, can possibly mimic the feeling of different objects or substances for users in VR.

TeslaSuit

The TeslaSuit is a complete full body suit with 68 haptic points and 14 inside-out motion capture sensors as well as 10 “climate points” that simulate temperatures from 10-40 °C (50-104 °F). It is compatible with Unity and Unreal Engine for integrating API, as well as with Windows OS, Android, iOS, XBOX and PlayStation.



TeslaSuit

AxonVR HaptX

[AxonVR HaptX](#) is not a suit but rather more of a working technological concept that currently resembles a hefty box. The system utilizes haptic textiles that simulate lifelike touch, allowing one to feel texture, shape, motion, vibration, and temperature. The effect is created by hundreds of small electronic actuators that apply pressure while consistently manipulating temperature. A full body haptic suit is currently in development and targeted towards enterprise customers.

HardlightVR

[HardlightVR](#) by NullspaceVR is an upper-body vest which uses 16 haptic pads to electro-stimulate the feel of impact and allows for programming of 16 families of variable and combinable effects. It also integrates inside-out tracking to enable a partial avatar in virtual space, instead of only simulating hands floating in space with handheld controllers. Nullspace is actively working with AAA developers to make the suit compatible with popular VR games.



HardlightVR
NullspaceVR

Rez Infinite Synesthesia Suit

The [Rez Infinite Synesthesia Suit](#) is not an actual suit but rather a collection of straps tightened around the body that utilizes 26 actuators to deliver electric stimulation. The system is in early stages of development, but is currently compatible with PSVR.

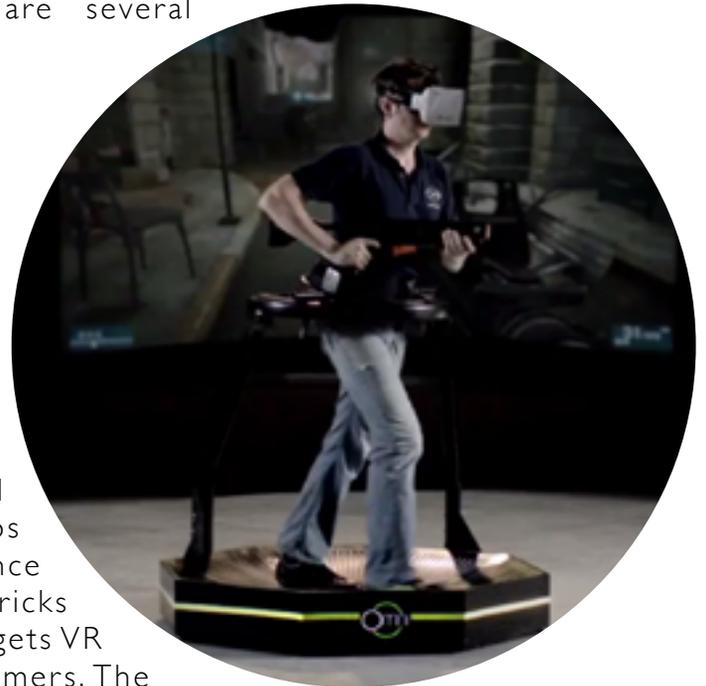
OMNIDIRECTIONAL TREADMILLS

Omnidirectional treadmills (ODTs) offer a solution to the lack of space for player movement in virtual worlds; they enable movement within a small space to achieve limitless and continuous movement in VR. Although it is still too early to tell how exactly VR systems will work in the future to enable full range of motion (either through more sophisticated ODTs, some system relying on galvanic vestibular stimulation, or just an accurately designed open space that mimics the virtual one), there are several early solutions already on the market.

Virtuix Omni

The [Virtuix Omni](#) is the most well-known ODT with a high-profile Kickstarter launch in 2013. Virtuix partnered early with multiple high profile game developers to integrate the Omni into existing games including Counterstrike, GTA, Fallout, and Minecraft.

The Omni utilizes a low friction surface to “walk” (slip) in any direction, wearing special shoes while a circular ring around the waist keeps the user in one place. Although the experience feels more like slipping on a surface, the Omni tricks the body into thinking it is walking. Virtuix targets VR arcades and other interested enterprise customers. The company recently announced a formal partnership with HTC to further develop content that takes advantage of the system.



Virtuix Omni

Kat Walk VR

[Kat Walk VR](#) aims for a less tethered and restrictive experience with an independent support structure and no rings or columns. It is a special high-friction, concave floor that, with a constant force of rolling friction, makes you feel like you’re walking on real ground, rather than “slip walking” like the Omni. Kat Walk is aiming their product at enterprise customers.

Vue VR

The [VueVR](#) treadmill is very similar in design to Kat Walk VR. Vue can be bought for \$699 by interested early adopters.

EXERCISE AND FITNESS

VR and AR both have plenty of potential in revolutionizing exercise and fitness using immersion and gamification. The fitness industry will certainly spur development in this area as popular fitness complexes look to lure members with compelling new experiences.

Gogi Play

The [Gogi Play](#) (\$119) designed by Blue Goji was originally created for smartphone/tablet iOS and Android systems to be used in tandem with an elliptical, stepper, or stationary bike. It consists of two straps with buttons that wrap around the handlebars, and the user runs the companion app with a library of games that upgrade the generic cardio routine into an immersive visual training experience.



Icaros
Icaros GmbH

Icaros GmbH

The [Icaros](#) is a complete VR exercise machine that already exists in over 200 high-end fitness centers in Tokyo, London and several other cities, with a cost of approximately \$10,000 per system. Although customers report a lack of content for getting through exercises, the machine shows promise in providing gym members with an alternative workout routine, with the promise of more content to come. A consumer version for home use is being developed to be released by the beginning of next year, with a target MSRP of around \$2,000.

VirZOOM

[VirZOOM](#) (\$399) is a complete hardware kit consisting of a spinning bike with buttons on the handlebars, plus games and software, although it requires a separately sold HMD. It utilizes integrated wireless sensors to track user movements and sensors measuring pedaling speed and registering the movement in the virtual world. Steering works by leaning one's body to the left and right. Action buttons, triggers and d-pad on the handlebars offer various inputs for games that can be developed for the system. VirZOOM has already created multiple experiences where users can ride a Pegasus, operate a tank or race a car, while playing mini-games to collect items and achieve higher scores.

GALVANIC VESTIBULAR STIMULATION (GVS)

GVS is the process of stimulating nerves in the ear that maintain balance, to induce a natural feeling of movement. GVS may eliminate motion sickness in VR while also enabling the feeling of motion. GVS can trick a subject into thinking they're moving when they are not, and may effectively deliver motion feedback for a user in VR.

Samsung's [Entrim 4D](#) headphones are the first product to take advantage of GVS. They are capable of delivering the sensation of 30 distinct patterns of movement. The headphones were announced at SXSW 2016 but are still in early development.

ADVANCED MOVEMENT TRACKING

Although the handheld controllers used with the Vive and Rift may be more natural than the previously used

traditional gamepads, they are not the best way to control interaction in virtual reality. Accurate hand and eye tracking (as well as voice control) are the next steps towards natural control in VR. Multiple companies including Facebook and HTC are working on integrating this technology in the next generation of headsets.

Leap Motion

[Leap Motion](#) has pioneered the development of accurate hand tracking and control for VR systems, most notably open sourcing its hardware for other developers with the OSVR kit. Over 200k developers are already working with Leap Motion. The hardware itself is essentially a small inside-out motion tracking camera that can be attached to a tethered or mobile headset and tracks hands at up to 200 frames per second, giving users a 150° field of view with roughly 8 cubic feet of interactive 3D space. The technology is still developing and is also applicable in augmented reality systems that utilize any type of gesture based input.

Developments in advanced inside-out tracking benefit not only VR but also all types of AR systems and as VR and AR synchronize into a synergetic mixed reality, so will the system we use to control it (hint: it will not be handheld).

Leap Motion



There are four types of capture solutions at play: the custom rig, the manufactured solution, the proprietary custom solution, and the DIY kit.

Parallels with “traditional” cinematography remain intact in VR: there is no one camera package to suit all conditions. Shooting conditions, lighting, subject and style all come into play when choosing the best solution. Some of these solutions are sold or rented. For an excellent overview of what is currently available click [here](#).

Custom Rigs

This is where 360/VR capture began: innovators took off-the-shelf cameras and components to assemble harnesses and 360 capture rigs. In the early days, this was done with GoPros and 3D printed plastic harnesses that would provide the correct geometry to create the desired capture effect (180, 270, full 360, or stereoscopic versions of the same). The sophistication has vastly increased to 16 8K Red cameras harnessed together. Some of these solutions are built to be sold or rented; some are made in-house by production companies.

Most popular camera rigs:

1. RED
2. SONY ALPHA
3. GoPro (Google Jump)
4. Nikon/Cannon DSLR
5. Black Magic
6. ZCam

The Manufactured Solution

As the medium continues to evolve we're seeing a variety of companies making self-contained 180° and 360° cameras. These are engineered from the ground up, to employ base components to create a unique camera solution. The downside is the requirement of considerable engineering and manufacturing expertise. The cameras, discussed below are more consumer to “prosumer” grade, and are meant to be sold at scale.



Camera Rig
RED

In some cases, these camera solutions are all-in-one— from capture to stitching to output. On the high end of the spectrum in this category, there is the Jaunt One or Nokia Ozo, which are manufactured units but require external solutions for operations and content assembly. (For instance, for Jaunt One, assembly is cloud based stitching.)

Here is a quick breakdown of several manufactured solutions:

1. [360 Fly](#)
 - a. 4K
 - b. Full 360 horizontal, 240 degrees vertical FOV
 - c. 64GB internal memory
 - d. Single lens, no seams = no stitching
 - e. Can shoot in 360 and standard 16:9
 - f. Dust and shockproof
 - g. Action cam mount accessory \$400

2. [Samsung Gear 360](#)
 - a. 2 F2.0 180-degree fish eye lenses,
 - b. Have the option of disabling one lens for a 180-degree shot instead
 - c. 25.9 Megapixels, 1920 HD
 - d. Certified IP53 for protection against harmful deposits of dust and against water sprayed at any angle up to 60° from the vertical
 - e. Compatible only with latest Samsung Galaxy phones
 - f. Requires external memory
 - g. \$350

3. [Ricoh Theta S](#)
 - a. 2 megapixels, 1080p HD, 30 FPS
 - b. Internal memory 8GB
 - c. 2 F2.0 180-degree fish eye lenses
 - d. Candy Bar design emphasizes portability
 - e. Special features: noise reduction, DR compensation, HDR Rendering
 - f. 25 min. max recording time for one video
 - g. Live streaming capability
 - h. High compatibility with social networks
 - i. IOS and Android support
 - j. \$325
 - k. New Ricoh Theta SC
 - i. maxes out at 5 min. record for a shot and no live streaming capabilities
 - ii. \$300



Gear 360 Camera
Samsung

4. [LG 360](#)
 - a. Dual 13 Megapixel lenses
 - b. 2K
 - c. Requires external memory
 - d. \$200

5. [Vuze](#)
 - a. \$800
 - b. Comes with mini tripod and Homido HMD
 - c. 8 lenses
 - d. Proprietary stitching technique
 - e. Vuze Studio

6. [Insta360 Pro](#)
 - a. 6 200° fisheye lenses
 - b. 4K @ 30fps (real time stitching) or 8K @ 30fps (post-production stitching)
 - c. 4K @ 25fps (real time stitch) or 6K @ 30fps (post stitch) for 3D stereoscopic
 - d. Supports H.264 and H.265 video codecs
 - e. 2x microphones w/ external microphone support
 - f. Optimized stabilization capabilities for action shots
 - g. Supports livestreaming to FB, YouTube, Periscope
 - h. \$3,499

7. [Z camera S1](#)
 - a. 4 190° fisheye lenses
 - b. 4K @ 60fps or 6K @ 30fps
 - c. 2 hour recording time
 - d. 4x directional mono microphones
 - e. Includes stitching software
 - f. \$2,499

8. [Live Planet](#)
 - a. 16x 180° lenses
 - b. 4K @ 30fps in 3D stereoscopic
 - c. Supports H.264 and H.265 video codecs
 - d. \$9,995

9. [Orah 4i](#)
 - a. 4 fish eye lenses
 - b. Built in stabilization and horizon correction
 - c. 30 fps 4k
 - d. Live processing unit AKA "Stitching box" enables live stream broadcast with push of a button
 - e. 4 HDR microphones; ambisonic 3D sound capture
 - f. \$2,595 pre-order, \$3,595 MSRP



LG360
LG



Orah 4i
Orah

- g. All metal body—thermally efficient for long streaming sessions
 - h. Compact design—optimal footprint to reduce parallax
 - i. Great Low light capabilities
10. [360 Designs Mini Eye 4](#)
- a. 4 185° lenses
 - b. 3K @ 60fps or 6K @30fps
 - c. Manual stitching
 - d. \$11,699-\$16,999
11. [Jaunt One](#)
- a. 24 130° lenses w/ global shutter
 - b. 8K-by-4K @ 30fps in 3D stereoscopic
 - c. Available for Rent from Radiant Images at approximately \$1000 a day
12. [Facebook Surround 360](#)
- a. [New versions](#) (announced at F8 this year) are the “x6” and “x24” with 6 and 24 lenses respectively
 - b. Full resolution; 6 degrees of freedom
 - c. Original version was an open source build - no final product or parts sold by FB
 - d. Facebook plans on licensing the new camera designs to a “select group of companies”



Jaunt One
Jaunt



Facebook Surround x24 (left),
Facebook Surround x6 (right)
Facebook

13. [Nokia Ozo](#)
 - a. 195° lenses with 100° of crossover between each, using a global shutter
 - b. 2K-by-2K @ 30fps in 3D stereoscopic
 - c. 8 microphones capturing spatial audio
 - d. \$45,000

Proprietary Solutions

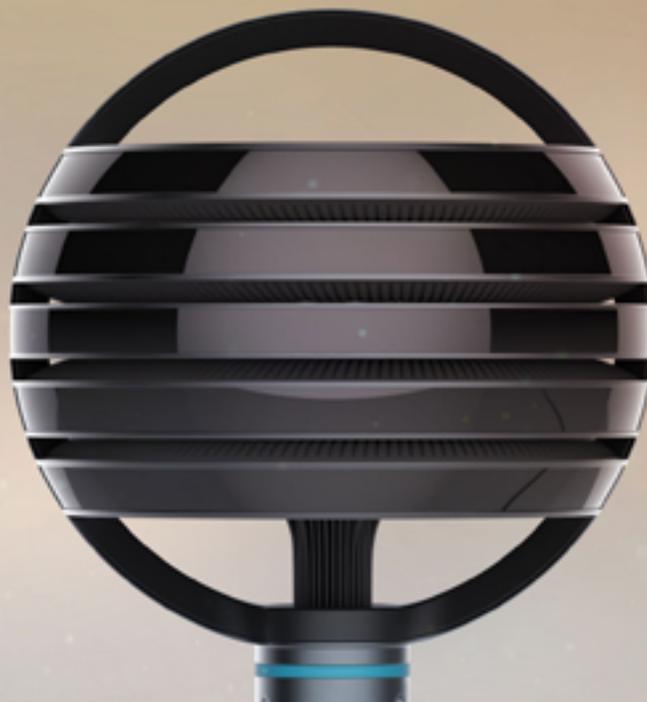
These are camera solutions that are typically made by or for production entities, and are held as part of the “secret sauce” for that entities content creation. A few 3D scene capture solutions are worth mentioning here.

[8i](#) is a New Zealand company that utilizes multiple DSLR cameras and a light stage to capture truly volumetric 3D video. Viewers can walk around and observe the model of the person, which is enhanced by editing to create an incredibly realistic animation. 8i recognizes the potential their technology must create immersive VR experiences that advance emotional connection and empathy.

Two other companies working on the similar technology are [TimeSlice Films](#) and [Sketchfab](#).

Camera company [Lytro](#) has been working on a proprietary light field camera rig named the [Lytro Immerge](#). Numerous sensors capture the entire light field in volumetric space (around one meter, according to the company), allowing

Immerge
Lytro



the viewer to examine in their environment in that area where the camera is shooting. A high quality 360° image is then assembled, which can be viewed in VR.

Unlike multi-camera setups which stitch together multiple images in a circular formation, thereby assuming the viewer's perspective to be completely horizontal, Lytro's setup provides stereoscopic depth and positional eye tracking so that the viewer is free to lean and roll their head inside the space. In addition to the rig itself, Immerge comes with a server box to store the massive amount of data captured by the camera. Compatibility with Nuke, Adobe Premiere, and Final Cut Pro through plug-ins along with integrated playback ability with the major HMD's will make Lytro Immerge the first end-to-end solution for live VR film making.

DIY

This category is an example of camera solutions that can be assembled based on plans. These range from the 3D printed plastic harnesses from [360Rize](#) to the brushed aluminum of [GoPro Omni](#) and beyond.

360Rize



2016 was perceived as “Year One” of Virtual Reality in China. Hundreds of VR companies cropped up to catch this wave.

According to Canalys, around 300,000 VR headsets shipping to China in 2016, making it the world’s second largest market, with a share of around 15%. Potential users (who have heard about VR and interested in it) are estimated to be 286 million, according to a China VR user behavior study by Baofeng Mojing, National Institute of Advertising, and Social Beta.

According to [2016 HICChina Virtual Reality Industry Research Report](#) conducted by iMedia Research, the scale of Chinese VR market is estimated to over 55 billion RMB (8 billion USD).

GOVERNMENT SUPPORT

Chinese Government is very supportive of the development of the VR industry. The China Electronics Standardization Institute released a white paper of VR industry development in April 2014, which aimed to promote the standards for VR/AR in China. It covered 5 key aspects: the current development (both domestic and international), features and characteristics of VR technology, the application of VR in key areas (including military, entertainment, medicine, industry, and education), and the possible improvements in the future and suggestions on government policies.

In May 2016, Xinhua News Agency, China’s official press agency, launched a VR/AR channel on its website.

[China’s 13th Five Year Plan](#) definitively states the government’s plans to industrialize immersive and interactive media: “New information technology will be supported by the government as a strategic emerging industry, while the industrialization of Virtual Reality and Interactive Film technologies as well as other emerging industries will be recognized as new sources of economic growth.” It continues, “We will support the development of next generation information technology, new-energy vehicles, biotechnology, green and low-carbon technology, high-end equipment and materials, and digital creative industries. In fostering new areas of economic growth, we

will spur innovation and industrial application in emerging, cutting-edge fields such as advanced semi-conductivity, robotics, additive manufacturing, intelligent systems, next generation aviation equipment, comprehensive service systems for space technologies, smart transportation, precision medicine, systems for high-efficiency energy storage and distributed energy, smart materials, efficient energy conservation, environmental protection, virtual reality, and interactive movies and television. “

LEADING COMPANIES

The leading factor in China's booming VR industry has been that the Internet Titans— “BAT” (Baidu, Alibaba, Tencent). All three are entering the market, announcing their plans, and investing in startups.

Tencent

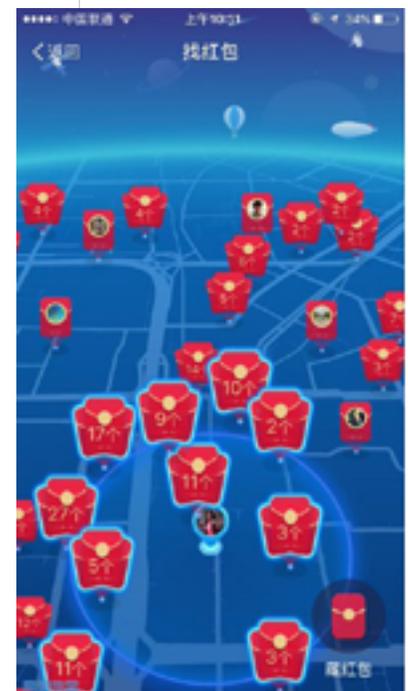
In 2015, [Tencent](#) became the first in BAT to declare its interest in VR industry, their plan initially centered on just games. Tencent is also [introducing their own HMD](#). They are interested in both mobile and PC based devices, planning to support apps, games, movies, and live-streamed event and developing their own VR games. Tencent VR also is planning to import the SDK from QQ and WeChat, which are the largest social platforms in China, suggesting a big play in social VR.

Alibaba

[Alibaba](#) is investing in VR/AR startups, including Magic Leap, Infinity AR, Lumus and WayRay. As China's biggest e-commerce company, Alibaba is focusing heavily on developing VR-related shopping experiences. In March 2016, Alibaba established its VR lab— GnomeMagic Lab. The first project of GnomeMagic lab is to build their own 3D product inventories and create the biggest 3D merchandise database. The goal is to help promote VR shopping experiences, and set up VR stores.

In July 2016, Alibaba introduced Taobao BUY+ plan at Taobao Maker Festival. Customers can browse items in a virtual mall, including Target, Macy's and Costco. [Alipay](#) recently launched [AR Red Envelope](#), a fresh take on a cultural tradition: Alipay users hide virtual hongbao, or red envelopes, at any location. Then, they upload a photo of the spot to the app along with a clue. The app automatically stores the location, for people to hunt. Users can track a hongbao by messaging the person who hid the treasure and

Alipay AR Red Envelope
Alibaba



asking for clues. When the envelope is located, the player scans the spot, and the hongbao will appear onscreen. One tap deposits the money stored in the hongbao into the treasure-hunter's Alipay account.

Alibaba are also developing VR based payment services under Ant Financial, and will produce VR content under Alibaba Pictures.

Baidu

In December 2015, Baidu launched a VR video streaming channel under its online streaming segment. In May 2016, Baidu launched Baidu VR+, a community to share and exchange information about VR. In September 2016, the China's largest search engine launched China's first VR web browser. It offers panoramic viewing, online video streaming and navigation.

In 2017, Baidu Ventures invested in Holographic-tech startup 8i, which is its first investment in VR/AR area.

[iQiyi](#), a Baidu subsidiary video streaming company, [launched its VR platform](#) in May 2016. It intends to build the world's largest Chinese-language VR service. It is working with more than 300 partners to produce content and hardware. It plans to create a new app suite, called iVR+, consisting of iVR Panorama Cinema and iVR Game Room, which makes its movies and games compatible with any HMD. It is also developing its own all-in-one VR device, which will debut in 2017.

JingDong

In September 2016, [JD.com](#) announced its VR/AR strategy, encompassing VR shopping experience and 3D models. JD will focus on AR experiences in home decoration and renovation, as well as logistics management. They have recently announced a [VR/AR e-commerce industrial alliance](#). JingDong also launched [VR.jd.com](#) and established a VR social networking community.

Baofeng Technology

Baofeng is one of the earliest VR headset businesses in China. In 2014, [Baofeng](#) had already released its first-generation product. By December 2016, it released its fifth-generation product. Originally, Baofeng focused on VR HMDs and Cardboard, but CEO Xin Feng has indicated that all-in-one, standalone VR headsets will be in the spotlight for 2017. In terms of content, the huge database

of its Storm Player offers various resources, also importing content from [Youku](#), [Tudou](#), and iQiyi.

Baofeng formed a partnership with [Sohu News](#) to produce VR news. Earlier this year, Baofeng established [Baofeng New Culture](#) to expand its business in VR tourism.

LeTV

[LeTV](#) has released their LeVR COOLI VR Helmet 3D HMD. It also released its own VR mobile app to provide content that is compatible with its VR HMD. Content is the center of the LeTV's VR plan. Its divisions—Le Vision Pictures, LeSports and LeMusic— will cover the VR content for film, concerts, sports, news, travel, education, games and other aspects. The company continues to seek cooperation with other companies to explore VR content. In terms of VR education they inked a partnership with [New Oriental Education & Technology Group](#); for VR News they partnered with [Caixin Media](#); for VR Home Decoration they partnered with [Tubatu](#).

NetEase

[NetEase](#) produced its first VR game Twilight Pioneers for the Google Daydream Platform. It experimented with AR technology in its new hit mobile game Onmyoji, which launched in 2016, quickly becoming the No.1 top grossing game on the Chinese App Store.

ELECTRONICS COMPANIES

HTC

HTC's main business is smartphones and tablets. In 2016, it expanded into the VR hardware market. HTC Vive, a high-end VR headset developed by HTC and Valve Corporation, was released in April 2016 and gained an 18% market share of total VR headsets in China in 2016. Vive Tracker, which adds motion to third-party accessories, debuted at CES 2017. On March 15th 2017, [HTC announced](#) its plans to sell a \$91 million phone manufacturing factory in Shanghai to support its VR business.

Xiaomi

[Xiaomi](#) released its [Mi VR Play](#) headset and Mi VR app. Their objective is to produce high-end, affordable headsets for consumers. The company has set up an “Explorer's Lab” focusing on research in artificial intelligence and virtual reality. Mobile VR is currently Xiaomi's focus, but it is also exploring the possibility of a standalone, all-in-one VR headset.

Textured metal button

Interactions happen most on the textured metal button - the sturdiest component on Mi VR Play. When pressed, a high-responsive conductive silicone button inside makes direct contact with your phone.

Anti-reflective lens

Mi VR Play Headset
Xiaomi

Huawei

In April 2016, [Huawei](#) introduced its VR headset—Huawei VR—which works with its P9, P9 Plus, and Mate 8 smartphones. In November 2016, Huawei introduced two new smartphones, Mate 9 and Mate 9 Pro, which are the first Google Daydream ready smartphones in China. As for content, Huawei is cooperating with Baofeng which is contributing existing film, TV, and gaming resources. Huawei is also partnering with Youku, which will connect its VR channel with the Huawei VR headset. Huawei is also addressing the bottleneck in broadband: the current 4G network is not adequate to support VR/AR at scale. Huawei proposed the concept of 4.5G network, while working towards a 5G network. Huawei also announced that it will cooperate with Insta360 to produce a clip-on 360° smartphone camera.

STARTUPS

DeePoon VR

DeePoon VR is a leading Chinese VR company that creates both mobile and PC-based VR hardware. It took 17% market share of headsets shipments in China in 2016. At CES 2017, DeePoon VR [introduced its next-gen systems](#): a PC helmet called E3, and a laser positioning solution called E-Polaris. Then, in March 2017, DeePoon VR and Dell announced a strategic cooperation. DeePoon will connect its new E3 product with Dell's devices to bring VR experiences to customers with lower expenses and therefore improve the whole VR ecosystem.

ANTVR

Established in 2014, ANTVR is focusing on developing VR headsets for PC and mobile, as well as VR cameras. The [ANTVR All-in-One](#) kit was funded via Kickstarter. The company has also designed VR HMD kits for Lenovo and Hisense, and released their ANTVR Camera in 2016.

VR/AR THEME PARKS

The Void

In February 2016, Shanda Group announced that it is one of the principal investors in [The Void](#), the most high-profile VR theme park project. Shanda Group is playing an important role in The Void's strategies, products, and management of Chinese market and has plans to bring The Void to China. They are still looking for a Chinese company that is competent and experienced as their partner in this project.

Pangolin VR Park

[HEI VR](#) is researching and developing their [Pangolin VR](#) theme park program. HEI VR has partnered with Carde Happy World in Jiangsu province and intends to build a 2700m² VR theme park. The theme park will include space exploration, e-sports, science world, and Pangolin entertainment.

Project Alice

[Project Alice](#) is Beijing-based Noitom's commercial B2B solution intended for VR entertainment zones and theme parks. Project Alice comes as an end-to-end solution for theme park and arcade operators including an optical system to track people and objects, inertial motion capture suits, motion gloves, and head-mounted displays (HMDs). Project Alice can be experienced in a gradient of configurations, from the full VR bodysuit to a simple HMD with controllers.

	AR/VR Company	Focus	Investment (\$M)	Funding round	Date	Investors (Firms)	Investors (People)
1	ZeroKEY Inc.	AR; Consumer electronics;VR	\$1.20	Seed	Mar-15		
2	2mee	Content, Android, iOS,AR	0.15	Seed	Apr-15	Angels Den	
3	Sketchfab	Real Time, 3D, Software, FinTech	7	Series A	Jun-15	Balderton Capital, Borealis, FirstMark Capital, Partech Ventures, Techstars	
4	Occipital	Real Time, iOS, Software, Mobile	13	Series B	Jul-15	Intel Capital, Draper Frontier, Foundry Group, Grishin Robotics, k9 Ventures, Shea Ventures	
5	Avegant	AR;Video; Mobile	24	Series B	Aug-15	500 Startups, Capital Community Angel Investors, CKM Capital Partners, CrunchFund, DN Capital, Hangzhou Liaison Interactive Information Technology, Intel Capital, Kaiwu Capital, Kickstarter, Michigan Angel Fund, NHN Investment	
6	Jaunt	Hardware, Media and Entertainment, Software	65	Series C	Sep-15	China Media Capital, Evolution Media Partners, GV, Highland Capital Partners, InnoSpring Seed Fund, Redpoint, Sky, The Madison Square Garden Company; Axel Spring; Disney; Participant Media; ProSieben-Sat.1 Media	
7	NullSpace VR	VR	0.55		Oct-15	Undisclosed	
8	8i	VR; 3D Technology; Software	13.5	Series A	Oct-15	Advancit Capital, BDMI, Boost VC, Dolby Family Ventures, End Cue, Founders Fund, Free-lands Ventures, Frontier Tech Ventures, Horizons Ventures, Inevitable Ventures, Kortschak Investments, L.P., Right Click Capital	Jeremy Stoppelman, John S. Hendricks, Kevin Wall, Scott Nolan, Walter Kortschak
9	Sturfree	VR; AI; Travel; Mobile	0.1	Convertible	Jan-16		
10	Envelop VR	VR; Enterprise Software; B2B	5.5	Series A	Jan-16	Madrona Venture Group; GV; KPCB Edge	
11	GeoCV	VR; SaaS; 3D Tech; Real Estate	--	Seed	Jan-16	Moscow Seed Fund; Starta Accelerator; Starta Capital; Universe Ventures	

AR/VR Company	Focus	Investment (\$M)	Funding round	Date	Investors (Firms)	Investors (People)
12 MagePrints	AR; Photography; Social Media	--	Non Equity Assistance	Jan-16	TechCode Accelerator US	
13 Spindle	VR; Photography; Mobile	--	Seed	Jan-16		Heatherm Huang
14 SpaceView	AR; B2B; Mobile	0.1	Debt	Feb-16	Right Side Capital Management; Portland Seed Fund (Seed & Debt)	
15 Immersal	AR; Software	0.11	Seed	Feb-16	Presence Capital	
16 SpaceoutVR	VR; E-Commerce; Mobile	0.25	Seed	Feb-16	Redwood Technology Ventures	
17 18Angles	AR; Collaboration; Virtualization	0.5	Seed	Feb-16	Alliance of Angels	
18 Digital Generals	VR; Info Tech; Content	0.5	Seed	Feb-16		
19 Fusion Tech Inc.	EdTech; Health Care; 3D Tech; VR	0.524	Debt	Feb-16		
20 KAT	VR; Internet	1	Angel	Feb-16	Unity Ventures; Xinyuan Investment	
21 Yost Labs	VR; AR; Autonomous Vehicles	1	Series A	Feb-16	Ohio TechAngels Fund; Tech-GROWTH Ohio; Tri-State Investment Group	
22 Janus VR	VR; Internet	1.58	Venture	Feb-16		
23 wrnch	AR; Computer Vision; Image Recognition; Software	1.8	Series A	Feb-16	Radical Ventures; Aligo Innovation; gr9k Technologies; Radical Investments LP; TandemLaunch	
24 Sphero	Robotics, AR, Gaming	3.12	Debt	Feb-16	Mercato Partners (Series E)	
25 WEVR	SaaS; entertainment; social; VR	25	Venture	Feb-16	AME Cloud Ventures; Boldstart Ventures; Digital Garage; Dragoneer Investment Group; Evolution Media Partners; HTC Corp; Orange Digital Ventures; Samsung Ventures	Ross Levinsohn; Scott McNealy
26 MindMaze	VR; Medical; Motion Capture	100	Venture	Feb-16	Hinduja Group	
27 Magic Leap	Wearables; AR; HMDs; Consumer Electronics; Software	793.5	Series C	Feb-16	Alibaba; Fidelity Investments; Google; JP Morgan; Morgan Stanley; Qualcomm Ventures; T. Rowe Price; Warner Bros.; Wellington Management	
28 Get Jenny	AI; VR	--	Seed	Feb-16	Nestholma	
29 HoneyVR	VR; Media Entertainment; News	--	Equity Crowdfunding	Feb-16		
30 Enyx Studios	VR; Service; Creative Agency	0.025	Grant	Mar-16	Innovation Fund Northeast Ohio	
31 Oriense	AR; Wearables; Embedded Systems	0.05	Grant	Mar-16	(Seed); RSV Venture Partners; TMT Investments	

AR/VR Company	Focus	Investment (\$M)	Funding round	Date	Investors (Firms)	Investors (People)
32 Cre8VR	VR; Digital Media; Social Media	0.1	Seed	Mar-16		Jason Trinidad
33 Look	VR; AI; Apps	0.272	Seed	Mar-16	Viralety Ventures	
34 Freeform Labs	VR; Content; Gaming	0.75	Non Equity Assistance	Mar-16	Starbreeze	
35 OSSIC	VR; Gaming; Audio	1	Seed	Mar-16		
36 Infinite360	VR; Publishing; News	1.12	Venture	Mar-16	Gate Ventures Plc	
37 Augment	E-Commerce; 3D Technology; AR; visual search	3	Series A	Mar-16	Salesforce Ventures	
38 Archiat Interactive	VR; Video Games	3.16	Venture	Mar-16		
39 VisionaryVR	VR; Internet; Software	6	Series A	Mar-16	Draper Fisher Jurvetson (DFJ); BDMI; End Cue; Greylock Partners; The Venture Reality Fund; Vayner/RSE	
40 Penrose Studios	Film Production; AR	8.5	Seed	Mar-16	Sway Ventures; 8 Angel; Suffolk Equity Partners; Translink Capital	Edith Yeung; James Riney; Kelsey Morgan; Tim McLaughlin; Victor Young
41 FOVE	HMDs	11	Series A	Mar-16	Colopl VR Fund; 2020 Ventures; Foxconn Technology Group; Samsung Ventures	Taizo Son
42 VOKE	Digital Entertainment; VR; 3D	12.5	Series A	Mar-16	Intel Capital; A+E Networks; Nautilus Venture Partners	
43 Blippar	AR; computer vision; AI; visual search; mobile	54	Series D	Mar-16	Khazanah Nasional	
44 Aira Tech Corp	Wearables; Machine Learning; AR	2.55	Series A	Mar-16	Lux Capital; ARCH Venture Partners; Felicis Ventures	Larry Brock; Scott Belsky
45 Metadrift	VR	0.07	Angel	Apr-16	QVentures	
46 Jahshaka LLC	VR; Publishing	0.1	Seed	Apr-16		
47 Photonomie	VR; Photography; Mobile	0.227	Seed	Apr-16		
48 Aero Glass	AR; VR; Aero-space	0.25	Seed	Apr-16	OXO Labs Ltd	Akos Maroy; Mortoff; Szabolcs Szakacsits
49 Cluster	VR; Internet; Apps	0.46	Seed	Apr-16	Skyland Ventures; East Ventures	
50 inVRsion	VR; B2B; Real Time	0.68	Seed	Apr-16		
51 Edorable	VR; 3D Technology; Education	0.75	Seed	Apr-16		

AR/VR Company	Focus	Investment (\$M)	Funding round	Date	Investors (Firms)	Investors (People)
52 SpaceVR	VR; AI; Space Travel	1.25	Seed	Apr-16	Shanda Group; Skywood Capital; Skywood Ventures	
53 LucidVR	Photography; AR; VR; Wearables	2.1	Venture	Apr-16	Lab360 Hardware Incubator; S2 Capital; TEEC Angel Fund; Wistron Corporation	
54 VRstudios	VR; Computer; Gaming	3	Venture	Apr-16	Stony Lonesome Group	
55 DataMesh	AR; Consulting; Big Data; Industrial Automation	3.09	Series A	Apr-16	IDG Capital Partners	
56 Marxent	AR; VR; Retail; Software	10	Series B	Apr-16	Detroit Venture Partners; Beck Besecker; Stage 1 Ventures	
57 Merge Labs	VR; HMDs; mobile	10.11	Venture	Apr-16	Tech Coast Angels	
58 Gazillion, Inc.	VR; Games; Mobile	11	Series A	Apr-16	Oak Investment Partners; ROTH Capital Partners	
59 Apollo Box	E-Commerce; AR	--	Angel	Apr-16		
60 Midas Touch Games	VR; Console Games	--	Venture	Apr-16	TEEC Angel Fund	
61 River Studios	VR; Marketing; Digital Entertainment	--	Debt	Apr-16	Frontier Tech Ventures; TranscendVR	
62 Ximmerse	VR; Cloud Computing; Visual Search; Mobile	--	Series A	Apr-16	Qualcomm Incorporated	
63 Pair Inc.	AR; Mobile; E-Commerce	0.125	Seed	May-16		
64 PRSONAS, Inc.	AR; Computer Vision; Software	0.525	Debt	May-16		
65 Aemass	VR; Digital Media; 3D	1	Venture	May-16		
66 DoubleMe	AR; VR; Virtual World; 3D	1	Grant	May-16	Korea Tech Incubator Program for Startup; National IT Industry Promotion Agency - NIPA; SparkLabs (Angel)	
67 Lucid Sight	VR; Gaming; Advertising	3.5	Series A	May-16	Rana Capital Partners; Salem Partners	
68 Littlstar	VR; Video Streaming; Advertising	5.24	Series A	May-16	645 Venture; A+E Networks; Social Starts; The Tornante Company	
69 Eonite Perception	3D Tech; AR; VR	5.25	Seed	May-16	Signia Venture Partners; Rising Tide; Presence Capital; Light-speed Venture Partners; CLI Ventures	Greg Richardson; Greg Castle; Andrew Gault; Andreas Bechtolsheim; Amr Awadallah; Nader Shenouda
70 roOomy	3D; AR; Retail; Interior Design	13	Series B	May-16	Antimeridian; Bertoia	

AR/VR Company	Focus	Investment (\$M)	Funding round	Date	Investors (Firms)	Investors (People)
71 Zeality Inc	VR; 360-degree video; social	--	Seed	May-16	Frontier Tech Ventures	Jason Khalipa; Paraag Marathe
72 Sessio Software	AR; Collaboration; Enterprise	0.055	Grant	Jun-16	Tekes; OP Financial Group (Debt)	Maria Mera; Mikko Mikkola; Tito Toivola; Tomas Westerholm; Vitalii Vasylenko
73 VisualPathy	VR; Content Delivery Network	0.5	Angel	Jun-16		
74 Primitive	VR; Graphic Design; Developer Platform	0.7	Seed	Jun-16	Boost VC; Draper Associates	
75 Against Gravity	AR;VR; Software	0.815	Debt	Jun-16		
76 Limitless	VR; animation	1	Seed	Jun-16	Colopl VR Fund; CRCM Venture Capital; Mission and Market; Social Starts; Sparkland Capital	Jay Rifkin; Masi Oka; Nick Rau
77 Dverse	VR; Interior Design; Training	1.04	Seed	Jun-16	Adways Inc; Colopl VR Fund; Incubate Fund; KLab Ventures; Slogan; Viling Venture Partners	Shogo Kawada
78 Loom.ai	Computer vision	1.3	Seed	Jun-16	Anorak Ventures; Danhua Capital; Presence Capital; Y Combinator	Joe Kraus; Zach Coelius
79 Tixsee	VR; Ticketing; Mobile Apps	1.75	Seed	Jun-16		
80 TimeLooper	VR; entertainment; tourism	1.85	Seed	Jun-16	Frontier Tech Ventures	
81 Cozy Cloud	Web Hosting; Cloud Computing; AR; Open Source	4.54	Venture	Jun-16	Innovacom; MAIF; Seed4Soft	
82 Felix & Paul Studios	VR; Digital Media; Content	6.8	Series A	Jun-16	Comcast Ventures; LDV Partners; PHI Group; Quebec	
83 Starbreeze	VR; Digital Entertainment	9	Venture	Jun-16	Acer; SmileGate	
84 Within	VR; Software; Apps	12.6	Series A	Jun-16	Andreessen Horowitz; Marker; 21st Century Fox; Annapurna Picture; Freelands Ventures; Legendary Entertainment; Live Nation Entertainment; Vice Media; WME Entertainment; Tribeca Enterprises	
85 uSens	AR;VR; Machine Learning; Computer Vision; AI	20	Series A	Jun-16	Fosun Kinzon Capital	

AR/VR Company	Focus	Investment (\$M)	Funding round	Date	Investors (Firms)	Investors (People)
86 Meta	AR; hardware; HMDs	50	Series B	Jun-16	Banyan Capital; Bold Capital Partners; Comcast Ventures; Danhua Capital; GQY; Horizons Ventures; Lenovo; Presence Capital; Tencent	
87 CryWorks	VR; Media Entertainment; Film	--	Seed	Jun-16	451 Media Group; 500 Mobile Collective; WI Harper Group	
88 Virtuka	VR; Photo Sharing; Video	--	Venture	Jun-16	Brithright Israel Excel Ventures Program	
89 PerfectaMe	AR; Retail; Fashion; E-Commerce	0.02	Debt	Jul-16		
90 FeelVR	VR; Gaming; Simulation	0.04	Seed	Jul-16	IoT Hub; Roman Kravchenko	
91 Umbo, Inc.	AR; Lifestyle; Electronics	0.175	Seed	Jul-16		
92 Dermandar	VR; Photo Sharing; Real Estate	0.35	Angel	Jul-16	BeryTech Fund	(Angel): Daniel Neuwirth; Georges Harik; Hala Labaki; Jan Erik Solem; Pierre Elzouki
93 AmbiensVR	VR	0.89	Seed	Jul-16	LVenture Group	
94 Paracosm	AR; 3D; Robotics; Real Estate	1.25	Venture	Jul-16	Osage University Partners; Atlas Venture (Seed Lead)	
95 ScopeAR	AR; software; training	2	Seed	Jul-16	New Stack Ventures; Presence Capital; Susa Ventures	
96 Radd3	AR; Software	2.2	Series A	Jul-16	HTC Corp; Presence Capital	
97 Kite & Lightning	VR; Cinema	2.5	Seed	Jul-16	Raine Ventures; Boost VC; Comcast Ventures; Courtside Ventures; Outpost Capital; Social Capital	Jason Rosenthal
98 Woofbert	VR; Education	2.54	Debt	Jul-16		
99 Vuzix	AR; Consumer Electronics; Eye-wear	6.6	Post IPO Equity	Jul-16	Intel Capital (Series A)	
100 Unity	3D technology; software; gaming; AR; VR	181	Series C	Jul-16	DFJ Growth; China Investment Corporation; FREES FUND; iGlobe Partners; Sequoia Capital; Thrive Capital; WestSummit Capital	Max Levchin
101 AVR	VR; AR; Gaming	--	Angel	Jul-16	Hacker Unit	
102 Banian Labs	AR; Internet; Travel; Apps	--	Seed	Jul-16		
103 SpectraVR	3D Technology; VR	--	Seed	Jul-16	Frontier Tech Ventures	
104 Second Studio	VR; Education; Enterprise	0.04	Seed	Aug-16	Rotolab	

AR/VR Company	Focus	Investment (\$M)	Funding round	Date	Investors (Firms)	Investors (People)
105 Obit Technologies	VR; Serious Games; Virtual Assistant	0.085	Seed	Aug-16		
106 ConstructVR	VR; Mobile; Software	0.12	Seed	Aug-16	Y Combinator	
107 Aurora AR	AR; Semiconductor; Biotechnology; Optical Communication	0.2	Seed	Aug-16	Hanhai Investment Inc.	Hong Yuan; Lucy Lv
108 Legion M	Digital Entertainment; VR	1	Equity Crowdfunding	Aug-16		
109 Superstar Games	VR; Video Game	1.25	Venture	Aug-16	IrisAngels; Presence Capital	
110 InsiteVR	VR; Architecture; Virtualization	1.5	Seed	Aug-16	GREE Ventures; CyberAgent Ventures; Frontier Tech Ventures; Y Combinator	Greg Castle; Ralph Gootee; Tracy Young
111 ManoMotion	AR; VR; 3D Tech	1.7	Venture	Aug-16	KTH Holding	Jakob Tolleryd; Lars Molinder; Lars Thunell
112 Pinscreen	AR	1.8	Seed	Aug-16	Colopl VR Fund; Lux Capital	
113 TheWaveVR	Digital Entertainment; Concerts; VR	2.5	Seed	Aug-16	KPCB Edge; Frontier Tech Ventures; Immersion Ventures; Luma Launch; Outpost Capital; Presence Capital; RRE Ventures; Seedcamp	Joe Kraus; Mike Fischer
114 Navisens	AR; Indoor Positioning; Mobile	2.6	Seed	Aug-16	Resolute.vc; Amicus Capital; Arba Seed Investment Group; KEC Ventures	Gokul Rajarm
115 Owlchemy Labs	VR; gaming	5	Series A	Aug-16	Qualcomm Ventures; Capital Factory; Colopl VR Fund; HTC Corp; The VR Fund	
116 Steel Wool Studios	Digital Entertainment; VR	5	Series A	Aug-16	HTC	
117 Sliverty	360-degree video; gaming; VR	6.2	Seed	Aug-16	COLOPL; DCM Ventures; GREE; Sierra Ventures; Sparkland Capital; The VR Fund	
118 Virtuix	VR; Consumer Electronic	7.7	Equity Crowdfunding	Aug-16	(Seed): 2020 Ventures; Houston Angel Network; Maveron; MSR Capital; QueensBridge Venture Partners; Radical Investments LP; Scentan Ventures; Scout Venture; SeedInvest; StartCaps Venture; Tekton Venture; Walden Woods Holdings; Western Technology Investment	Bradley C. Harrison; Mark Cuban

AR/VR Company	Focus	Investment (\$M)	Funding round	Date	Investors (Firms)	Investors (People)
I19 NextVR	broadcasting; wn- ertainment;VR	80	Series B	Aug-16	CITIC Group Corporation; Comcast Ventures; Dick Clark Productions; Formation 8; RSE Ventures;The Madison Square Garden Company;Time War- ner Investments	Peter Guber
I20 Boundless Reality	VR; Media Enter- tainment; Film	--	Seed	Aug-16		
I21 Coolhobo	VR; E-Commerce; Food & Beverage	--	Seed	Aug-16	Chinaccelerator; SOSV	William Bao Bean
I22 Matterport	VR; Digital Media; 3D Tech	--	Venture	Aug-16	CBRE Group; Luminari Capital	
I23 Qoobex	VR; Broadcasting; Social Network; 3D Technology	--	Angel	Aug-16		
I24 3DLOOK	AR; 3D Tech; Celebrity	0.03	Debt	Sep-16		Igor Ere- min;Vadim Rogovskiy (Seed)
I25 Alphachannel	AR; Social Net- work; Marketing	0.1	Seed	Sep-16	Capital Innovators; Newark Venture Partners	
I26 Drone League Racing	Drones; Racing; VR	1	Seed	Sep-16	Sky; Courtside Ventures	
I27 Briskeye	VR; Video; Broad- casting	1.28	Venture	Sep-16		
I28 TimefireVR	Content; Devel- oper Tools;VR	1.5	Private Equity	Sep-16	Cavalry Fund; Hudson Bay Capital Management	
I29 LifePrint	AR; Printing; Mobile	1.65	Debt	Sep-16		Craig Vachon
I30 InstaVR	VR; SaaS; mobile apps	2	Series A	Sep-16	The VR Fund	Francisco Pereira
I31 Polyarc	VR; gaming	3.5	Seed	Sep-16	Colopl VR Fund; UCCVR; Vulcan Capital	
I32 LiveLike	broadcasting; sports;VR	5.01	Series A	Sep-16	CAA Ventures; Courtside Ventures; Dentsu Ventures; Evolution Media Partners; Residence Ventures; Techstars Ventures	David Stern
I33 Vertebrae	Advertising Plat- forms;VR	10	Series A	Sep-16		
I34 ROOBO	Robotics; AI; VR; IoT	100	Venture	Sep-16	Iflytek Co Ltd	
I35 Osso VR	VR	--	Seed	Sep-16	Presence Capital	
I36 Embodied Labs	VR; Healthcare	0.025	Seed	Oct-16	Creative Startups	
I37 TinyPCB	Wearables; Semiconductor; Medical Device; Robotics;VR	0.25	Debt	Oct-16		

AR/VR Company	Focus	Investment (\$M)	Funding round	Date	Investors (Firms)	Investors (People)
138 Hyperverser	VR; Gaming	0.4	Debt	Oct-16	Starta Accelerator (Seed)	
139 moBack	VR; AR; Mobile Apps	0.5	Seed	Oct-16		John Ostrem
140 iGOTCHA	AR; VR; Web Development; Gaming	0.564	Undisclosed	Oct-16		
141 Univrse	VR; AI; Virtual Assistant	0.891	Undisclosed	Oct-16		
142 VRChat	VR; social	1.2	Seed	Oct-16	Brightstone Venture Capital; Frontier Tech Ventures; GREE VR Capital; HTC Corp	
143 First Contact Entertainment	VR; Digital Entertainment; Gaming	5	Venture	Oct-16		
144 Iris VR, Inc.	VR; 3D Tech; Architecture	8	Series A	Oct-16	Emergence Capital Partners; Indicator Venture; Valar Ventures	
145 InContext	Retail; software; VR	15.2	Series F	Oct-16	Beringea; Intel Capital; Hyde Park Venture Partners; Plymouth Ventures	
146 Baobab Studios	8th Wa	25	Series B	Oct-16	Horizons Ventures; Evolution Media Partners; LDV Partners; Shanghai Media Group; Youku Global Media Fund	
147 Kernel Co.	AR; Hardware; Software	100	Venture	Oct-16		Bryan Johnson
148 VRIZE	VR; Developer Platform	--	Seed	Oct-16	B Dash Ventures; Speee	
149 Taction Enterprises	Musical Instruments; VR; Consumer Electronic	0.095	Angel	Nov-16		
150 PsycApps	VR; Information Technology; Medical	0.311	Seed	Nov-16		
151 Virtual SugerySIM	VR	0.335	Angel	Nov-16		
152 Hashplay Inc.	VR; Internet; Mobile	0.5	Venture	Nov-16	Metatron Global	Alexander El Gammal; Klaus-Peter Stegen
153 Bublar	AR; VR; Gaming	0.557	Undisclosed	Nov-16		
154 AppOnboard, Inc.	VR; Developer APIs; Data Visualization	1	Seed	Nov-16		
155 NGCodec	VR; Cloud; AR; Wireless	1	Seed	Nov-16	Belmore Capital	
156 Tactical Haptics	Hardware; Gaming; VR	1.47	Seed	Nov-16	SV Tech Ventures; Sand Hill Angels; SIG China; Stanford-StartX Fund; Youku Global Media Fund	

AR/VR Company	Focus	Investment (\$M)	Funding round	Date	Investors (Firms)	Investors (People)
157 Fieldbit	AR; Enterprise Software	2.21	Venture	Nov-16		
158 8th Wall	AR; VR; Computer Vision; Mobile	2.4	Seed	Nov-16	Betaworks; Greylock Partners; Norwest Venture Partners; SV Angel; The Venture Reality Fund; Third Kind Venture Capital	
159 nDreams	VR; Internet; Publishing	2.49	Venture	Nov-16	Mercia Technologies	
160 Soul Machines	AI; E-Learning; VR	7.5	Series A	Nov-16	Horizon Ventures; Iconiq Capital	
161 obEN	AI; IoT; VR	7.7	Series A	Nov-16	CrestValue Capital; Cybernaut Westlake Partners; Dream Maker Entertainment; E3 Capital Partners; Idealab; Imaginator; NewDo Venture; Shenzhen Leaguer Venture Capital; Third Wave Digital	Gordon Cheng
162 Infinity	AR; AI; Enterprise Software	18	Post IPO Equity	Nov-16	Alibaba; Sun Corporation	
163 Glo Inc	VR; Content; Digital Entertainment	--	Seed	Nov-16	MindWorks Ventures	
164 INKHUNTER	AR; Computer Vision; Apps	--	Debt	Nov-16	Kayon Partners; Entrepreneurs Roundtable Accelerator (Seed)	
165 Rain	AR; VR; 3D Tech; Computer Vision	--	Debt	Nov-16		
166 VRee	VR; Information Technology	--	Seed	Nov-16	BOM Capital; LUMO Labs	
167 WTFast	VR; Gaming; SaaS; Content Delivery Network	--	Series A	Nov-16	VA Angels	
168 Xanadu Heights	VR; Video Games	--	Seed	Nov-16	Redcliffe Capital	
169 GlassUp	AR; Consumer Electronics; Sports; Hardware	0.27	Equity Crowdfunding	Nov-16	European Union, UniCredit Group	Federico Palumbo, Francesco Giartosio
170 Reality Reflection	VR; Gaming	--	Venture	Nov-16	Stonebridge Capital	
171 Kabaq	AR; Food Menu	0.18		Dec-16	The Glimpse Group	
172 Taqtile	AR; VR; Enterprise applications	0.5	Debt	Dec-16	Lighter Capital	
173 Neurable	AR; VR; Human Computer Interaction	2	Seed	Dec-16	Loup Ventures; NXT Ventures; PJC	Brian Shin; Robert Winter
174 Drifter Entertainment	VR; gaming	2.25	Seed	Dec-16	Anorak Ventures; Initialized Capital; Pathbreaker Ventures; Presence Capital; Signia Venture Partners; The VR Fund	
175 Visbit	360-degree video; VR	3.2	Seed	Dec-16	Amino Capital; COLOPL; Ever Sunny; Presence Capital; ZhenFund	

AR/VR Company	Focus	Investment (\$M)	Funding round	Date	Investors (Firms)	Investors (People)
176 STRIVR Labs	AR;VR; Enterprise	5	Series A	Dec-16	Signia Venture Partners	
177 AxonVR	AR;VR; Hardware	5.8	Seed	Dec-16	Dawn Patrol Ventures;Keeler Investment Group	Dick Costolo; Jon Snoddy; Paul Matthaeus
178 Zero Latency	VR; gaming	7	Venture	Dec-16	Carthona Capital	
179 Atheer	AR; hardware; HMDs	14	Series B	Dec-16	Signatures Capital; Streamlined Ventures; FundersClub; RONAHoldings; Shanda Group	
180 High Fidelity	VR; social	22	Venture	Dec-16	Breyer Capital, IDG Capital Partners	
181 Survios	Hardware; Gaming;VR	50	Series C	Dec-16	Lux Capital; MGM; Danhua Capital; Dentsu Ventures; Felicis Ventures; Shanda Holdings; Shasta Ventures; WiL	
182 Oster Design Group	AR; Wearables; Consumer Electronics	58	Series A	Dec-16	21st Century Fox; Shenzhen O-film Technology; Vanfund Urban Investment & Development	
183 Owlized	AR; Audio; Virtualization	--	Non Equity Assistance	Dec-16	Skydeck Berkeley; Keiretsu Forum Northwest	
184 Pillow's Willow VR Studio	VR; Gaming	--	Seed	Dec-16	LUMO Labs	
185 Wolfprint 3D	VR; 3D Tech; Gaming	--	Seed	Dec-16	Startup Wise Guys	
186 Virtual Xperience Inc.	VR; Real Estate	0.15	Seed	Dec-16		
187 Obsess	VR; E-Commerce, Retail	0.02	Angel	Dec-16	Asimov Ventures	
188 Pandora Reality	VR; AR; Gamification; Enterprise	0.1	Seed	Jan-17	BlueCap, ETohum	Ali Rıza Babaoğlu, Hüseyin Emre Yılmaz
189 FOV	VR; Photography; Social Media; Mobile; Computer Vision	0.2	Private Equity	Jan-17		
190 Pixelbug	AR, SaaS, mobile	0.5	Seed	Jan-17	Turn8, Prime Venture Partners	
191 Remoria VR	VR; Software Engineering; Information Technology	0.74	Seed	Jan-17	Invitalia Ventures; LVenture Group	
192 Mimesys	VR; AR; Collaboration; Enterprise	1.07	Angel	Jan-17	LRM	Koen Desmedt, Frank Bekkers
193 SkyLights	VR; Digital Entertainment; Air Transportation	1.3	Seed	Jan-17	Bragiel Brothers; Comcast Ventures; David Gurle; Plug and Play; Presence Capital; Y Combinator	

AR/VR Company	Focus	Investment (\$M)	Funding round	Date	Investors (Firms)	Investors (People)
194 Spaces	Computer, Software, VR	6.5	Venture	Jan-17	Boost VC, Canyon Creek Capital, Colopl VR Fund, Comcast Ventures, CRCM Venture Capital, GREE, Sinovation Ventures, The Venture Reality Fund, Youku Global Media Fund	Kai Huang
195 Digilens	AR; Product Design; Manufacturing	22	Series B	Jan-17	Alsop Louie Partners, Bold Capital Partners, COntinental AG, Dolby Family Ventures, Foxconn Technology Group, Nautilus Venture Partners, Panasonic, Sony	
196 Lumus	AR; Wearables; Consumer Electronics	30	Series C	Jan-17	Crystal-Optech; HTC; Quanta Computer; Shanda Group, Alibaba Group	
197 Binary Bubbles	AR; VR; Media and Entertainment; Video Games	--	Seed	Jan-17		
198 VR Connection		1		Jan-17		
199 Arraiy	Machine Learning; AR; VR	3.86	Seed	Jan-17	CRCM Venture Capital, IDG Capital Partners, Lux Capital, Shenzhen Valley Venture, SV Tech Ventures, Youku Global Media Fund	
200 Skullfish Studios	VR; Graphic Design	0.03	Seed	Jan-17	GameFounders	
201 Flexound Systems	VR; AI; Music	0.97	Venture	Jan-17		
202 Virtualistics	VR, AR, software	3	Seed	Jan-17		
203 Lithodomos VR	VR, Software, Architecture	0.68	Seed	Jan-17		
204 vGolf	Mixed Reality; Golf	--	Seed	Feb-17		
205 Agility Technologies Corp.	VR; Homeland Security; Communication Hardware	0.32	Debt	Feb-17	Social Finance	
206 SubVRsive	VR; Marketing; Advertising	4	Series A	Feb-17	WPP Ventures	
207 NUVIZ	AR; Consumer Electronics, Automotive, IoT	--		Feb-17	Husqvarna, Pankl Racing Systems, Pierer Industrie, WP Suspension	
208 uBUTLER	Virtual Goods, VR	--	Seed	Feb-17		
209 AccuPS	3D Technology, VR0.1		Seed	Feb-17		
210 8i	3D Technology, Computer, Software, VR	27	Series B	Feb-17	Time Warner Investments, Baidu Ventures, Hearst Ventures, Verizon Ventures, One Ventures, Seen & Speed Ventures	

AR/VR Company	Focus	Investment (\$M)	Funding round	Date	Investors (Firms)	Investors (People)
211 Against Gravity Immersive VR Education	AR; Software; VR	5	Venture	Feb-17	Acequia Capital (Acecap), Anorak Ventures, Betaworks, First Round, Maveron, Sequoia Capital, The Venture Reality Fund, Vulcan	
212 Wemersive	Education; VR	1.06	Venture	Feb-17		
213 Schell Games	VR; 3D Engines; Mobile				SBIR; National Institute of Health	
214 Dreamscape Immersive	AR; VR; Connected Toys, Interactive Experiences				21st Century Fox, Bold Capital Partners, IMAX, MGM, Warner Bros, Westfield Corporation	Steven Spielberg
215 Lytro	Gaming; VR	11.36	Series A	Feb-17	Allen & Company, Blue Pool Capital, Danhua Capital, EDBI, Foxconn Technology Group, GSV Capital, Huayi Brothers Media Group	Barry Sternlicht
216 LiveEdu.tv	Photography, Hardware, Software, Film, Video, VR	60	Series D	Feb-17	Angel Round Capital, EuropeanPioneers, Y Combinator	
217 Walkthrough	VR; Education; Video		Venture			
218 Imagine	Residential, Real Estate, VR	0.33	Angel	Jan-17		
219 Imagine	AR, Software, VR	0.5	Seed	Feb-17	SRI Capital	
Total Funded		\$2,344.59				

Research compiled by
Alice Shen and Michael Hoydich

*THIS DOES NOT INCLUDE EVERY INVESTMENT IN THE SPACE, AND DOES NOT REPRESENT THE TOTAL FUNDING TO DATE.

The following list features leading VR projects as well as some notable recent festival entries, all with links.

ALLUMETTE

STUDIO: [PENROSE STUDIOS](#)
DIR. EUGENE CHUNG

“Six degrees of freedom is huge. It adds so much to what we call ‘presence,’ which in many ways is the holy grail of virtual reality. How do we move and think in this medium? Allumette is about thinking natively in virtual reality.”

— Eugene Chung

Allumette brings viewers into a magical city in the clouds—Dr. Seuss meets Cirque de Soleil. We wind through its street, following a little girl named Allumette and her mother. The navigation-driven story uses the power of room-scale VR beautifully. Allumette elevates the platform with one of the first truly original cinematic VR experiences.

To see a 2D clip, click [here](#)

Available from: Viveport, Steam, Oculus Store



CLOUDS OVER SIDRA

STUDIO: [WITHIN](#)
DIRECTORS: GABO ARORA,
CHRIS MILK

“By leveraging breakthrough technologies such as virtual reality, we can create solidarity with those who are normally excluded and overlooked, amplifying their voices and explaining their situations.”

— Gabo Arora



The groundbreaking *Clouds Over Sidra* was one of the first projects to prove VR's power as an "ultimate empathy machine," and a potential agent of social change. *Sidra* brings viewers into the world of a 12-year old girl named Sidra, who guides the audience through her temporary home: the Zaatari Refugee Camp in Jordan. *Sidra* helped UNICEF double its donation rate; after one screening, the UN's Humanitarian Pledging Conference in Kuwait raised \$3.8 billion—nearly twice the projected revenues.

To see a 2D clip, click [here](#)
Available from: Within app, YouTube 360

DEAR ANGELICA

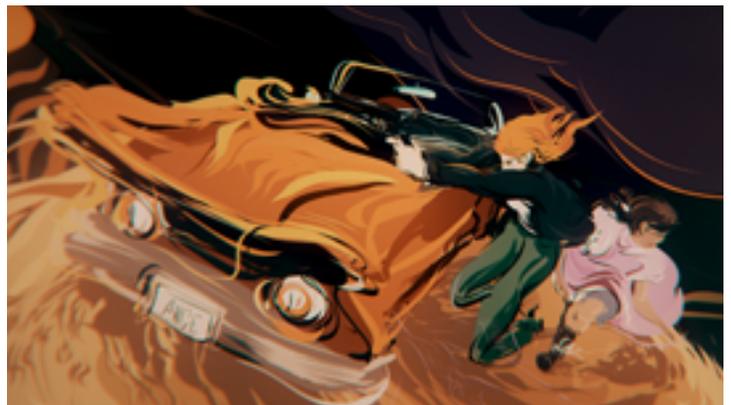
STUDIO: [OCULUS STORY STUDIO](#)
DIRECTOR: SASCHKA UNSELD

"It should feel like a lucid dream in that way that things appear and disappear in a nearly effortless way. We can use that to basically string up these narrative moments."
— Saschka Unseld

2017's *Dear Angelica* is another breakthrough: an experience created from inside VR space, rather than outside of it. *Angelica* was authored in Oculus' Quill, a tool that allows developers and artists to create experiences while they are moving through the very space that the audience will occupy.

Dear Angelica occurs in the world of a young woman named Jessica—a boundless, abstract world, filled with painterly 3D shapes. Music and *Angelica*'s voice (Geena Davis) fill out the world of the grieving daughter, as we walk through her memories of her mom—witnessing fragments of the story, and of *Angelica*'s memories, in a story painted in space and sound.

To see a 2D clip, click [here](#)
Available from: Oculus Store



GNOMES AND GOBLINS

STUDIO: [WEVR](#)

DIRECTOR: JON FAVREAU

“Don’t be afraid to explore and look and try different things and look everywhere. Even if you do it through once, do it again.”

— Jon Favreau

A magical combination of VR and game play, Gnomes and Goblins sets players in the middle of an interactive enchanted forest, teeming with fireflies, tiny cottages, and rope bridges. You explore the village, and build playful relationships with creatures along the way. Gnomes suss you out, walk up to you, maintain eye contact, and toss you magical objects. You can ring a bell to awaken more fireflies, play fetch, or open windows.

To see a 2D clip, click [here](#)

Preview available from: Viveport, Steam



HENRY

STUDIO: [OCULUS STORY STUDIO](#)

DIRECTOR: ROMERO LOPEZ DAU

“When we set out to make Henry, it was a step into the unknown world of making an emotional VR movie.” — Ramiro Lopez Dau

Henry transports the viewer into the magical homes of an adorable hedgehog named Henry—as the lone guest at his birthday party. Oculus’ positional and eye tracking enable Henry to look at you beseechingly... till you forget that you’re looking at an illusion, not a living breathing creature. It won an Emmy in 2016.

To see a 2D clip, click [here](#)

Available from: Oculus Store



THE LAST GOODBYE

STUDIO: HERE BE DRAGONS

DIRECTORS: GABO ARORA, ARI PALITZ

In July of 2016, Holocaust survivor Pinchas Gutter toured the Majdanek Concentration Camp in what he vowed would be his final visit. By marrying a stereo video capture of Pinchas within a photorealistic room scale experience, The Last Goodbye reaches profound levels of immersion in service of the first ever VR testimony that will be archived and preserved. The importance of listening to Pinchas' story is more important now than ever and this is also a beautiful testament to love, compassion and the human spirit.

To see a 2D clip click [here](#)
Not yet available



LIFE OF US

STUDIO: [WITHIN](#)

DIRECTORS: AARON KOBLIN, CHRIS MILK

“For some reason, humans have this funny thing about where we came from — it always has far more emotional weight than where we are.” — Chris Milk

Like Dear Angelica, Life of Us premiered a few weeks ago at Sundance. The seven-minute piece consists of scenes from across time and space, comprising what studio Within refers to as “the complete story of life on Earth.” Life of Us is a highly interactive, social VR experience that toes the line between game and narrative. Up to four people can experience evolution together, evolving from single-celled organisms, fish, dinosaurs, apes, and more.

To see a 2D clip, click [here](#)
Not available yet



THE MARTIAN VR EXPERIENCE

STUDIO: [THE VIRTUAL REALITY COMPANY](#)

DIRECTOR: ROBERT STROMBERG
(BASED ON RIDLEY SCOTT'S FEATURE FILM)

"A new medium gives opportunities to new artists, and we are cultivating that. We don't see virtual reality as a marketing tool—we see it as a new way to visualize entertainment."—Ted Schilowitz, FOX Innovation Lab

The Martian VR Experience was created as a supplement to 20th Century Fox's *The Martian*. The viewer sees Mars through stranded Earthling Mark Whatney's eyes... and must figure out how to get back to Earth. As you sort your food, plant a flag, and operate a rover, crane, and rocket, the interactions deepen the experience, and heighten the sense of presence.

To see a 2D clip, click [here](#)
Available from: Oculus Store, Steam

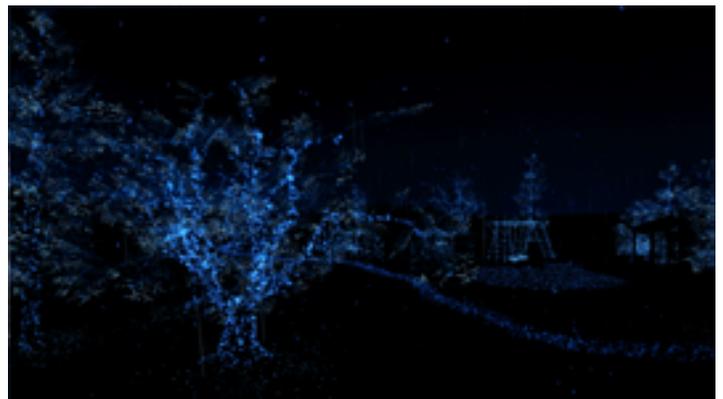


NOTES ON BLINDNESS: INTO DARKNESS

DIRECTORS: PETER MIDDLETON, JAMES SPINNEY

This immersive experience documents John Hull's journey with blindness. After losing his sight in 1983, Hull began recording an audio-diary. This diary is the basis of the experience, and ponders a world beyond sight, to explore the interior world of blindness.

To see a 2D clip, click [here](#)
Available from: Google Play, Oculus Store, Within app



NEUROSPECULATIVE AFROFEMINISM STUDIO: HYPHEN-LABS

DIRECTORS: ASHLEY BACCUS-CLARK,
CARMEN AGUILAR Y WEDGE, ECE
TANKAL, NITZAN BARTOV

NeuroSpeculative AfroFeminism is an empathic exploration into the experience of women of color. It takes place in a futuristic cosmetics salon (a neurocosmetics lab), when humanity has transcended its bodily limitations.

To see a 2D clip, click [here](#)
Available from: Oculus Store

PEARL

STUDIO: [GOOGLE SPOTLIGHT STORIES](#)
DIRECTOR: PATRICK OSBORNE

“[VR is] a visual medium, that’s how we want to communicate... You’re trying to touch people with your artwork.
— Patrick Osborne

Pearl takes place in one car over twenty years.

The viewer is in the passenger seat, as the landscape changes and characters grow. Without dialogue, it tells the story of a father and a daughter as she grows up. Distributed in both 360 and 2D, Pearl is nominated for an Academy Award for Best Animated Short

To see a 2D clip, click [here](#)
Available from: Viveport, YouTube 360, Google Play



THE PEOPLE'S HOUSE

STUDIO: FELIX AND PAUL

DIRECTORS: FELIX LAJEUNESSE, PAUL RAPHAËL

The People's House takes the audience on a historic visit of President Barack Obama and First Lady Michelle Obama's White House. The Obamas guide the audience along a journey inside the West Wing and Private Residences. They talk about their time there, and the building's history.

To see a 2D clip click [here](#)
Available from: Oculus Store



THE PROTECTORS: WALK IN THE RANGER'S SHOES

STUDIO: [HERE BE DRAGONS](#)

DIRECTORS: KATHRYN BIGELOW, IMRAAN ISMAIL

The Protectors chronicles a day in the life of the rangers in Garamba National Park. These rangers are often the last line of defense in a race against the poachers intent on slaughtering elephants for their ivory tusks. The rangers face constant danger and even death, at the service of these sentient, noble creatures.

Available from: YouTube360, Within app
To see a 2D clip click [here](#)



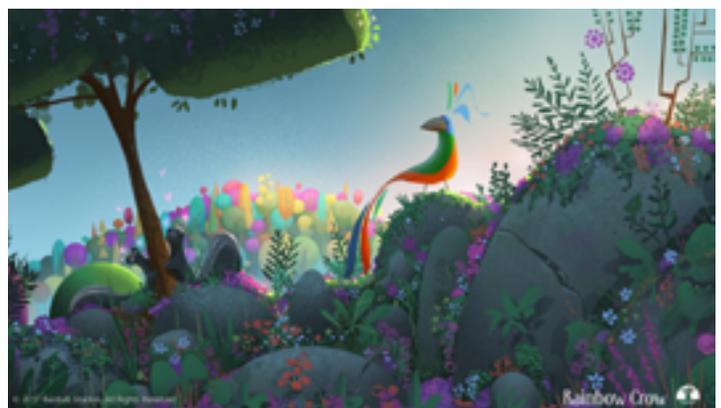
RAINBOW CROW

STUDIO: [BAOBAB STUDIOS](#)

DIRECTOR: ERIC DARNELL

In this experience, users step inside a heart-warming and musical land. The carefree forest animals imagine spring will last forever. However, winter comes and the animals soon realize that their lives are in danger. What they need is a hero; what they need is *Rainbow Crow*.

Not yet available
To see a 2D clip click [here](#)



TILT BRUSH

STUDIO: [GOOGLE](#)

DIRECTORS: PATRICK HACKETT AND DREW SKILLMAN

“When I left Disney in 2012, I told them it was because I know there’s something new coming... “The goal [of Tilt Brush is] to animate not on paper but in space,” he said.
— *Legendary Disney animator Glen Keane*



Google’s Tilt Brush may be VR’s “killer app” thus far—allowing users to create and interact with their art in actual 3D space. It received a Proto Award for Best Graphical User Interface, and a Unity Award for Best VR Experience. Tilt Brush marked one of the first steps in making native animation tools mainstream and also recently incorporated multi-user, collaborative abilities. It paved the way for others such as Oculus’ Medium and Quill.

To see a 2D clip, click [here](#)

Available from: Steam, Oculus Store

TREE

STUDIOS: [NEW REALITY COMPANY, HERE BE DRAGONS](#)

DIRECTORS: MILICA ZEC, WINSLOW PORTER

Arms become branches, and the body becomes the trunk. From seed to fullest form, the user assumes the tree’s role in the majestic rain forest, and experiences its fate firsthand.



To see a 2D clip click [here](#)

Not yet available

TREEHUGGER:WAWONA

STUDIO: [MARSHMALLOW LASER FEAST](#)

DIRECTORS: BARNABY STEEL, ERSIN HAN
ERSIN, ROBIN MCNICHOLAS

This is an interactive installation that combines art, science, data, environmentalism and technology in an immersive environment. The user is transported into a tree's secret inner world. The longer someone hugs the tree, the deeper they drift into "treetime," a dimension that lies beyond the limit of our senses.

To see a 2D clip click [here](#)
Not yet available



THE WALK VR

STUDIO: [CREATEVR](#)

DIRECTOR: ROB SILVA

"Once consumers have had a VR experience based around a specific project or brand—they are invested—they've had a personal experience and their relationships with the material is forever changed."
— David Stern, Owner/Founder, CreateVR

A (relative) oldie but goodie, The Walk VR was created as a marketing extension of Sony's Joe Gordon Levitt feature The Walk, by Create Advertising. In it, the user relives Philippe Petit's terrifying walk between the two World Trade Towers.

When CreateVR originally demoed The Walk, they added haptic elements: a cut hose on the floor to simulate the wire, and a fan to simulate wind. As a result, at least 30% of viewers just could not bring themselves to walk the walk. To see why, watch the clip below.

To see a 2D clip, click [here](#)
Available from: Google Play, Steam



OTHER GREAT TITLES

ADRIFT, Three One Zero | [here](#)
After Solitary, Emblematic Group/Frontline PBS | [here](#)
Dreams of “O”, Cirque de Soleil | Felix and Paul Studios | [here](#)
Halcyon, SyFy, Secret Location | [here](#)
Mr. Robot VR, Here Be Dragons | [here](#)
My Brother’s Keeper, PBS Digital Studios | [here](#)
Old Friend, Wevr | [here](#)
Project Syria, Emblematic Group | [here](#)
Sleepy Hollow Experience, Secret Location | [here](#)
Eve: Valkyrie, CCP Games | [here](#)

FESTIVAL SELECTIONS

TRIBECA 2017

Alteration

Studio: [Okio-Studio](#)
Director: Jérôme Blanquet

APEX

Studio: [Wevr](#)
Director: Arjan van Meerten

Arden’s Wake

Studio: [Penrose Studios](#)
Director: Eugene Chung

Auto

Project Creator: Steven Schardt

Bebylon Battle Royale

Studio: [Kite and Lightning](#)
Directors: Cory Strassburger, Ikrima Elhassan

Becoming Homeless: A Human Experience

Studio: [Virtual Human Interaction Lab, Stanford University](#)

Broken Night

Directors: Alon Benari, Tal Zubalsky, Alex Vlack

Draw Me Close

Director: Jordan Tannahill

Extravaganza

Director: Ethan Shaftel

Hallelujah

Studios: [Within](#), [Lytro](#)

Directors: Zach Richter, Bobby Halvorson, Eames Kolar

The Island of the Colorblind

Director: Sanne de Wilde

The Other Dakar

Studio: [Electric South](#)

Director: Selly Raby Kane

Talking With Ghosts

Studio: [Oculus Story Studio](#)

Directors: Ric Carrasquillo, Roman Muradov, Sophia Foster-Dimino, Maria Yi

Testimony

Studio: [Kaleidoscope VR](#)

Director: Zohar Kfir

Unrest

Studios: Shella Films, Ex Nihilo, Little By Little Films

Directors: Jennifer Brea, Amaury La Burthe

SUNDANCE 2017

Asteroids!

Studio: [Baobab Studios](#)

Director: Eric Darnell

Chasing Coral: The VR Experience

Studios: [View Into The Blue](#), [Seaview 360](#)

Director: Jeff Orlowski

Chocolate

Studio: [Gentleman Hands](#)

Director: Tyler Hurd

Hue

Studios: [Marry the Moon](#), Framestore Ventures

Director: Nicole McDonald

Melting Ice

Studio: [Condition One](#)

Director: Danfung Dennis

Mindshow

Studio: [Mindshow](#)

Directors: Gil Baron, Jonnie Ross, Adam Levin

Miyubi

Studio: [Felix and Paul](#)

Director: Felix Lajeunesse, Paul Raphaël

Orbital Vanitas

Studio: [BADFAITH](#)

Director: Shaun Gladwell

Out of Exile: Daniel's Story

Studio: [Emblematic Group](#)

Director: Nonny De La Peña

The Sky is a Gap

Director: Rachel Rossin

Through You

Studio: [Oculus Story Studio](#)

Directors: Saschka Unself

Zero Days VR

Studio: [Scatter](#)

Directors: Yasmin Elayat, Elie Zananiri

INTERVIEW: GRANT ANDERSON, JAUNT (2016)

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*INTERVIEW CONDUCTED BY SETH SHAPIRO

JANUARY 2016.



Grant Anderson is Head of Studio for Jaunt VR, one of the leading providers of premium cinematic VR experiences. Jaunt leapt to prominence with its Android and iOS apps, and with VR partners including Paul McCartney, the North Face, Disneyland and ABC News. The company recently completed a \$65 million Series C with investors including Disney, Evolution Media Partners, Participant Media; and China Media Capital. Prior to joining Jaunt, Grant worked with companies including Sony Pictures Disney, Stan Lee Media and Apple.

Q. What brought you to into VR, and to Jaunt?

Grant: I came here was because Jaunt was a frontrunner. They had their hands in the whole pipeline, from beginning to end. But what really drew me to VR from the film industry is this is really truly the first new medium we've had in dozens of even hundreds of years since film, basically. Maybe video games.

So, it's a chance to be truly innovative and I think that's what excites people. We're creating, and building, and extending what is the language of cinematic VR. When do you get to do that, come in on the ground floor of a new medium? So that's what I think is drawing most people here.

Q. How would you describe Jaunt?

Grant: Well, Jaunt started about two years ago, primarily, as a technology company. I mean our founders, our CEO and CTO, were serial Silicon Valley entrepreneurs, so they started many different tech companies. And one of them was on vacation and said, "Wouldn't this be great if we could share this with the world?"

They had the idea of putting this camera together, a video camera system that could capture a full 360 image which led to VR and that research. And they created a series of cameras, eventually leading to our first production camera, called the GPI6. It's basically a collection of GoPros in a housing, but heavily modified along with our own software algorithm, created to stitch everything together in the cloud. That's our cloud-based component, which is now called Jaunt Cloud Services.

So, they had, really, one of the first perfectly built VR cameras. And they started shooting content. And it turns out the content was really good. And so they got a lot of attention for it. And they quickly realized, of course, that content is king and really wanted to be in the content business. And so, Jaunt morphed into becoming a content and a distribution company.

It's the camera acquisition system on the frontend, the Jaunt cloud services and a suite of software tools and platform in the middle, and then a distribution app on the end. And we're hardware agnostic, both on the front end and the back end. Meaning, yes, we build cameras but we're not really a hardware company. We build cameras as a means to an end.

We're also using [Nokia's] cameras, and we use others. We're really looking for the best tools for the job to create the best content for our platform. So, in the end, that's what Jaunt really is, it's a content and a distribution company.

Q. What distinguishes great VR or transformational VR content from the stuff... that just isn't interesting?

Grant: I come from the 3D filmmaking industry as of late, having been Executive Director of Sony's 3D Center and doing 3D films. And that was the problem back then. There was a lot of junk in the early days and that's true with VR. Everybody jumping in because it's the latest, greatest thing.

There's a lot of hype out there, and a lot of creative potential, as we talked about. But there's a lot of junk that's coming out too. I mean, the good VR content is like any content, first and foremost, story drives it. **Is it a good story, are you engaged? Nothing else is going to save that.** Number two, there needs to be a high production value. Some of this stuff is incredibly difficult to look at, especially stereo production of which the best VR is in stereo and full 360.

A lot of people are doing mono work. That's okay, but I don't think that's the full experience because what you really want is a virtual reality. **And what everybody talks about is presence, the feeling that you're actually there, or in the piece.** And that's what's so transformative with virtual reality. And so you really want those elements.

So you need a good story. You need high production value. It needs to be comfortable to look at. You don't want to be making your audience sick. There's a lot of issues with the camera motions and movement and people trying to use their 2D sensibilities within this new cinematic language, which doesn't always work. It's a lot of trial and error but all those things have to come together to really feel present in the material.

Q: Are there particular projects that stand out for you, either from Jaunt or others?

Grant: ***The North Face: Climb*** was one of our most popular pieces, where you're actually out in Moab, Utah, in Yosemite, and you're on these huge mountain cliffs. We had the camera on a drone, which was the first time we ever did that and didn't know how it would work but it actually worked out pretty well. It's a beautiful, amazing experience that's experiential, but also takes you on a little journey.

Another really cool piece that we just did, which raced up the charts was the **Disney Small**

World Experience, which we did during the holidays, where you're actually on the Small World ride with Mickey and Minnie and going through that. So it just shows you the power of VR, where you can be in that front row seat at your favorite sporting event or concert. You can be on the ride of Disneyland, even if you may not be able to make it, so that's really amazing.

In the CG realm, one of my favorites of last year, which I'm a board member of the Advanced Imaging Society, and Chairman of their VR Committee. And, last night, we had the Creative Arts Awards, where we recognized the best 3D films and, now, high dynamic range and ultra HD. And, also, VR was our first award last night for that.

And we handed one out for Sony and Create: LA, **The Walk VR Experience**. That was really one of my favorites of last year. It's CG based, where you're on the corner of the Twin Towers, walking out on that tightrope, just like in the film, looking down, and they put an actual rope under your feet. And it's motion tracking, so as you're walking out on the rope, you're actually moving around in the full environment. And it is absolutely terrifying. It's really an amazing piece.

Q. Absolutely. One of the things that Create mentioned to me was that as many as 3 out of 10 people that try The Walk VR are like, "No, I can't do this!" Even though they know it's not real, that nothing about it can hurt them. That's got amazing implications – for phobias, traumas, etc.

Grant: Yeah. I was one of those people. My legs were shaking and you keep telling yourself, "You're on the ground. You're on the ground. You're on the ground." But your brain is going, "No way!"

Q. As a filmmaker and as a 3D guy, where does VR fit, in terms of creating narrative?

Grant: So, I always say, I think the killer app of virtual reality is going to be at the intersection of cinema, gaming and interactive theater. So I think all those three elements to me, in my gut, seem to be like the magic combination.

At Jaunt, right now, we're focusing on cinematic virtual reality – meaning, we're filming the real world. We're creating narratives in the real world, using the new languages of cinematic VR, whatever that is and whatever we're building that out to be as a community. But, we also have limitations with what we can do with that right now.

It used to be that doing CG was very difficult and filming something, "Just go film it," was a lot easier. Well, now, it's almost the opposite. Filming in virtual reality is more difficult than doing things in CG because we have certain limitations. Unless you move the camera, you can't move about the space. To do that, it's going to take either physically scanning the entire space and turning it into a cg simulation, or light field technology, which we and other companies are working on, for sure, but that's several years out. And we'll still be limited in volume with which you can move around.

So, on the flip side, you have the CG real-time graphics engines, in which you have full autonomy to move around and manipulate objects and control that. So, it's very freeing but it's also this synthetic world. So, we're trying to bridge the gap where you have elements of

both, where you're in a CG or film/cinematic VR environment. But, yet, we have interactivity on top, allowing you to control the path through the film, manipulate objects within reality of all those different kinds of things. But I do think you need some interaction, ultimately. Not in everything but on many projects, because you do feel so present in the material that you feel like you need agency in that world.

Q. So for a filmmaker, the viewer traditionally has a predetermined, fixed position that's dictated by the camera's position, and by editing. In VR, the viewer can be the driver of that position. How does that change the process of crafting story?

Grant: Well, two things there. One is the idea of your narrative – versus a narrative that a viewer can control. That's one issue. I don't think we're not quite sure where VR is going to be on that. But I think it's going to be a combination of the same three things: cinema, gaming, and interactive theater. This is something that the gaming community has been working on for around 20 years. How do you tell a compelling narrative that's satisfying, but that the viewer has control over? It's difficult. Really, really difficult.

But I think we're going to have to have some of that in VR. And, in terms of the window into the world, yeah, we don't have a window anymore and that's why it's a windowless world, right? You can look anywhere you want. And so that's where the challenge comes in production, where, how do we draw the viewers' attention to what we're trying to get them to look at? And that's basically using the tools of motion, light, and sound.

You can force the viewers' perspective – but that's been proven to not be very satisfying and also can make people sick. You could put arrows hanging in the air but that's a little weird and obtrusive. **So, you have to either use those cues of motion, light, and sound to guide the viewer or wait until the viewer looks** – and use gaze detection and to let the story unfold once they finally do look there.

One of the things I should mention is a lot of people think that now that we're filming in 360 that we need to have action unfolding on the camera at all times like, "Isn't this great? Look, people are running around the camera, or there's multiple people performing around the camera." **That's getting old really quick**; it's the equivalent of the 3D world and 3D filmmaking where somebody's always poking you in the eye with something coming out the screen. So, I'm like, "Let's just stop that right now." Because you don't want to feel like you're in a tennis match when you're watching something in VR. You really, physically, get tired very quickly.

People, even in VR, still only look in a 30 to 60-degree arc, like in real life. Generally, you're scanning side to side to your head, tiny bits. And every once in awhile, if you hear something, you look at something behind you, you'll do that. So we need to take that into account in filmmaking. And, right now, a lot of it's very gimmicky.

Q: Do you see an inflection point that brings the medium to a critical mass? Or is one not required?

Grant: You know what? It's really undetermined. I mean, anybody that would tell you differently is a liar. Nobody knows what's going to happen. And there's all kinds of forecasts and all that kind of stuff, which are very lively, but we just don't know. I mean, consumers are fickle so we'll see if they take to it.

But this is the year of VR. This is the launch pad, basically. This is year one. Because, all the three major headsets shipped, but those are going to be very niche. We know they're not going to sell millions and millions of units. They're targeted towards gamers. They're expensive, if you've seen the prices that were announced, more expensive than we thought, including having to buy a powerful computer to actually run it. And so, it's going to be targeted towards gamers, which itself is a niche. So it's a niche of a niche. So there's not going to be huge numbers.

And so this is the same kind of feeling I had in 3D. There's so much money and so much hype going into it, and then everybody disillusioned. Like, the trough of disillusionment, the hype curve and then the trough of disillusionment, and then you rise out of the valley of despair, all of that stuff. You can kind of see that here, hopefully it's not. I think it's different. It's just so immersive and so compelling and you're not aware of your real world. You really are transported somewhere else. But, it's going to be a niche and I think the press will see and say, "Look, all of them shipped and the numbers are small and VR is over." There's going to be that, for sure, probably.

But, I think it will then definitely pick up. These things are going to get less expensive. They're going to get smaller, lighter, more comfortable. And then, for us, we really view the biggest platform is going to be the cellphone. Because, everyone has one in their pockets. This is all the technology that allowed VR to reemerge anyways. And people, companies, Apple, Samsung, others will start building more and more specific VR tech into phones, to enable better experience, including head tracking and motion tracking and all that kind of stuff. And, it's very inexpensive.

There's all kinds of little goggles on the market for 10 bucks you can get off Amazon. You can drop your phone in plastic headsets, and a million different Chinese companies, very inexpensive, and allows you to have a better experience. I mean Google Cardboard is great but you're limited in the amount of experiences you can have because you have to hold it up to your face because your arms get tired.

But there's going to be a million different devices, and millions of different configurations. And the price points.

Google Cardboard is essentially free. I mean they're given out everywhere. So, we really do see the cellphone as one of the main entry points, if not one of the main drivers, of the whole industry.

INTERVIEW: GABO ARORA

UNITED NATIONS & LIGHTSHED (2017)

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*INTERVIEW CONDUCTED BY SETH SHAPIRO

APRIL 2017



Gabo Arora is an award-winning filmmaker and Founder & Creative Director of LightShed, a virtual reality and social impact start-up. His work focuses on new technologies that promote social causes and make decision-making processes more inclusive. Among these projects is a viral video campaign for the recent climate change summit in Paris, and various collaborations with internet influencers to promote accountability

on global humanitarian aid assistance. He has also directed and produced a series of pioneering, and widely acclaimed, virtual reality documentaries for the United Nations focusing on vulnerable populations in crisis.

Clouds Over Sidra, Waves of Grace and My Mother's Wing have all premiered at major film festivals around the world, including Cannes, Sundance and Tribeca, featured at the World Economic Forum in Davos, screened at the White House, and have exhibited at the Museum of Modern Art's inaugural program on immersive storytelling.

Background

My background is as a development economist. I studied emerging markets at Johns Hopkins University, political economy with Francis Fukuyama, who is my mentor and the professor who ran the international development program when I was at Hopkins.

Before that, I studied philosophy and film at NYU. I always had aspirations to be a filmmaker, writer, artist. And then 9/11 happened, and I just felt that I needed more life experience. I wanted to get a lot more connected to what was happening on the planet.

Basically, I did just that. I was full-time at the UN by 2009. I worked in the field in Haiti, was in Colombia for a couple of years. I lived for a year in Bolivia, Tanzania, Zambia. I've been in India with the World Bank.

By 2011 I was back in New York, and was in the office of the United Nations Secretary General, Secretary-General Ban Ki-moon, as a Senior Policy Advisor.

I would help write reports, but my goal then would be to get people to care about the issue: influencers, decision-makers, general public, civil society. I looked for ways to convince them with more than just numbers.

I'd also have to engage with celebrities, write op-eds, and try to use traditional forms of getting our message out.

By 2012-13, I was seeing bloggers and technology succeed at this. For instance, Humans of New York is a blogger on Facebook. He singlehandedly has more Facebook followers than all of the UN groups and social media teams combined... more engagement, for sure, because people are passionate about the stories that he tells.

I felt that we needed to embrace new technology. We needed to embrace something that would be relevant to how people were consuming information and making decisions. In 2013, I did a viral video campaign for the climate change summit, which has almost 2 million views. It's called "Keep the Oil in the Ground." Then I called up Humans of New York, and produced his UN tour—a lot of storytelling would be that he would generally do on the streets of New York, what that would look like in Iraq, in the Congo.

That was a fundamental experience for me, a big success. It led to almost a million more followers for him and our issues in seven weeks. Just, again, proving out the use of new technologies.

At that same time, I heard about VR. This was probably October 2014. I'd never tried it, could only understand it abstractly. But my intuition was that if it was half as amazing as people were saying it could be, then it would be something that would be amazing for getting people to understand our issues at the UN.

Around the same time, I was working with the newly-elected Norwegian prime minister. A lot of the UN's work is in Africa, and she had never been to Africa. So, I did a three-country tour to get her to understand the main issues. And I tried to do something that would give her the most authentic, most real way to understand the issues shaping people's lives there.

When I first went to Africa, to Namibia, in 1999, I had all these misconceptions. It took a while for me living in a shanty town to even start to have some understanding of what people are like. And I wanted to get the prime minister to understand more quickly.

So, when I heard of virtual reality, I thought: if we were able to give people access to other people's lives, maybe that would make all the difference.

When I heard about VR, I did what I usually do, which is to start talking to everybody, wherever it took me, asking people “how does this work?” Then we worked on the ONE campaign with Bono and U2. At the launch party, Bono and I spent 40 minutes talking about the borough of Queens... because that’s where all the Irish are, of course, and the Ramones. And at the same party, I met someone from Samsung who worked in VR.

CLOUDS OVER SIDRA

Eventually, we pitched the Edge on the idea of doing VR in a refugee camp, and his eyes widened, and thought it was a great idea. And he introduced me to Chris Milk, who had been wanting to do something like this for a long time.

Then Chris gave me a demo, his and Beck’s Sound and Vision project, that just blew my mind. And I knew right away that we had to do something together. And I said, “I have no money. But if you give me your camera, I’ll figure it out. I’ll go down there. It’s going to be great.”

And that was end of November. Two weeks later, I’m in a refugee camp filming Clouds Over Sidra with Barry Pousman. And since then Barry and I have worked together on My Mother’s Wing, Ground Beneath Her, and other projects.

And that’s how it happened. We got it ready for Davos, and then Sundance in 2015, and the response was incredible. But some people didn’t get it, because there weren’t that many headsets at the time. We had Samsung come from Korea with 150 headsets to Davos a day before the event. And some people just watched it as a stretched-out image and didn’t like it.

But we did it, by hook or by crook. And then it began to have a life of its own, because it was great, and people reacted to it. That’s what got me into VR. Chris and Patrick Milling Smith of Here Be Dragons have been early investors in getting this stuff made, and very supporting of all the work.

Then I remember at Sundance, I was like, “Thanks a lot, Chris. This was amazing.” And he said, “Well, we’ve got to do more. We’ve got to do more... there’s no shortage of great stories to be told, so you should keep doing it. You’re great.” And, you know, he’s a real strong mentor of mine, and close friend now.

WAVES OF GRACE

After Sidra, I mentioned to Chris that I wanted to do something on Liberia, and the Ebola crisis. He said, “that’s amazing. Let’s do it.” I did Waves of Grace there, while Ebola was raging. We tried to give people an understanding of what’s happening there, especially through the eyes of a survivor. And then I thought “what next?”

MY MOTHER'S WING

My Mother's Wing, our Gaza film, world premiered in Tel Aviv. I was feeling that this technology is very powerful to give people a sense of what it's like in places that they couldn't usually go to. And I thought that there is no place people have less understanding of than Gaza. People don't have access to Gaza, because you have to be a part of the UN, or you have to be a journalist, and even then, it's a very long, arduous process to get into Gaza.

We were very heavily watched while we worked on the project. The shoot wasn't technically during a war, but it was over the summer that it happened, there were constantly skirmishes, little bombings, things always happening at night and in different places. There was a lot of tension.

Filming that was probably one of the most difficult things, but also one of the most inspiring, because you realize how beautiful the people are, how misunderstood they are, and how most people are just like you and I, just trying to get through the day, get their kids to school, eat something, and live their lives.

It was an instance where my UN credentials could be used able to be used for good. And I applied for the permit. I lobbied. I did everything I could. And just to be able to do and film and produce anything out of there is a miracle, because you don't see that much stuff, whether it's in VR or not.

My Mother's Wing was shown on the streets of Israel. It was amazing to give people an understanding that they would never have, because the regular media doesn't give that kind of perspective.

What was even more touching was that it has been at Tel Aviv. It's been at the Jerusalem Film Festival. To have it world premiere in Tel Aviv at Tel Aviv University was astonishing.

THE LAST GOODBYE

The Last Goodbye is my eighth project in VR. It's in room scale, and will premiere at Tribeca in late April. The Last Goodbye is the first archived testimony from a genocide survivor for the Shoah Foundation for the future, which is incredible.

At each step, I've been lucky. But I think we get supported because we've been able to show impact with it— with our face to face fundraisers at UNICEF doubling donations. And we make sure our projects are artistically creative and technologically innovative. Storytelling-wise, we try to do something different each time, and we try to make a difference with them, you know? It's been a wild ride.

I feel immensely grateful, and somewhat vindicated, that people want more than just sex and violence from this medium— things like Notes on Blindness, and the stuff coming out of James George's studio Scatter. It's proving the point that people want content that matters.

I think we need to continue to figure out a way to support that. I'm very touched that Oculus VR for Good was inspired by *Clouds Over Sidra* and built a VR for Good program around that model.

And I hope that we make it accessible so that people can continue to tell these stories, and that there's a space for them. I hope no one forgets this sort of moment, and I hope what we've been able to achieve with a lot of the work that I've been a part of with so many amazing people . . . because of course it's not just me. It's a lot of people who get behind a lot of these things. Hopefully it leaves its mark on how this industry will continue to evolve, and people won't forget that we need to think about it in more than just the way we thought about other content.

I'm hopeful, because it just seems like each time I go to a festival, there are incredibly meaningful, awesome stories. I just hope that it's not just this early indie period, and then it gets all into comic books or whatever it is. I hope that this type of stuff is fostered. I think it will, because the world's becoming a more urgent, difficult, fractured place, and people are expecting more from not only their storytelling, but from their technology. I'm excited and honored to be being a part of that.

INTERVIEW: WILLOW BAY,

USC ANNENBERG SCHOOL FOR COMMUNICATIONS AND JOURNALISM (2017) 20

*INTERVIEW CONDUCTED BY PERISA BROWN

APRIL 2017



Willow Bay, a veteran television journalist, digital news editor and author, is the Dean of the Annenberg School of Journalism at the University of Southern California. Bay also serves as Senior Strategic Advisor for the Huffington Post and is a special correspondent for Bloomberg Television.

Based in Los Angeles, Bay has reported from numerous special events for Bloomberg TV, including the Milken Institute Global Conference and the Clinton Global Initiative. Bay also hosted “Women to Watch,” Bloomberg TV’s primetime program that profiled the next generation of women leaders in various industries. She regularly interviews top business and thought leaders including former President Bill Clinton, Pepsi Chairman and CEO Indra Nooyi, Tesla Motors CEO Elon Musk, Vice President Al Gore, IAC Chairman Barry Diller, and former Bear Stearns CEO Alan Schwartz.

From 2007 to 2014, Bay was a Senior Editor at the Huffington Post, managing editorial content and growth initiatives for the on-line news and commentary site. Working closely with founders Arianna Huffington and Ken Lerer, she managed the launch of over a dozen news, business and lifestyle content verticals including 8 metro pages across the country. Bay interviewed investor Warren Buffet, Facebook’s Sheryl Sandberg and His Holiness the Dalai Lama, for the site’s first global live-streaming event.

Willow is currently a Vice Chair of the Board of Trustees of the Los Angeles County Museum of Art and serves on the Board of Trustees for the Center for Early Education. She lives in Los Angeles with her two sons and husband, Robert Iger.

Background

I was a broadcast journalist for the bulk of my career. More recently, I was a Senior Editor and then a Senior Strategic Advisor at the Huffington Post. That allowed me, at the very beginning of the expansion of Huffington Post, to work at the intersection of content creation and technology.

That experience shaped a lot of my thinking about journalism and communication in technology. The editorial team worked side by side with the web programmers and the tech team. The CTO would sit with the senior editors, and we would develop new tools and deploy new technologies together, which is a different model from what I had seen before in legacy media.

From there, I came to USC with a combination of legacy and new media journalism experience, and with management experience in the online space.

Education and Technology

I think it's imperative for all of our students, graduate and undergraduate, to have a fluency and ease with contemporary technologies. And that includes emerging technologies.

With coding specifically, our goal is not to turn our students into programmers. It's to introduce the language of coding, which really empowers journalists to create, fix, or tweak the tools they use to communicate with their audiences. I see it as a language requirement; just understanding how that language works and how it directs and shapes the tools that you use is what's important.

Q. How is virtual reality being integrated into the journalistic curriculum at USC?

The point of those classes is to experiment with these new technologies, taking them apart and putting them back together again to develop a facility with something new in the technological space. And then using them in the service of journalism, which means using these technologies through the lens of a journalist.

When I came to USC, one of my goals was to partner with journalists and technologists as we did during my time at the Huffington Post. I think it's critically important that the tools we create and deploy be shaped with the values of journalism, with the values of communication.

One of the things that I hope we're beginning to do as we move beyond the early experimentation phase of VR is that we begin to think about and document best practices. What are the ethical considerations of using VR? Can we document, for example, the belief about VR, which is that it increases empathy by the very intimate nature of the storytelling? It's our supposition that we can, but how do we know that's the case?

I think that's starting to happen now. Carnegie-Knight is doing interesting work, Frontline has been really active in the VR space. I think now that we're actually starting to use it as a journalistic device, we need to begin to develop best practices and be thought leaders in this space, and not just technology users.

Q. What do you think is the biggest challenge with adapting journalism to VR?

There are lots of technical challenges to VR, both in terms of shooting it, and then distributing it in a way that makes sense. I think that's our first line, getting through those technological hurdles — for the whole industry, not just in journalism. I also think there are a lot of ethical considerations about a 360-degree view of someone's intimate experience.

Q. How do you think journalistic content will change as a result of VR?

I think it is changing—just by the addition of 360 or VR to the journalism mix. It is increasing opportunities for consumers to engage with news and information content.

Q. Social media has resulted in news having unprecedented reach and momentum across its audience. Do you think that's going to be sustainable in VR?

The technological hurdles right now are going to keep this experience narrow to a small subset of the population. I think what we see is the role of the “anchor” or the role of the “reporter” as a gatekeeper diminishing. It appears as if there's no guide or gatekeeper, but in fact the shooter and producer are doing just that but in a less physical way.

Q. Is it less invasive this way?

I'm not sure it's less invasive, because in a weird way it's more invasive. What I mean is that in some ways the ability to tell that story in such an immersive way is more invasive of your personal space, but the role of the guide, anchor, or reporter is not front and center.

Q. Digital media has given rise to individual people as brands that can be monetized. Do you think that could happen with VR even with the traditional “anchor” or “gatekeeper” removed?

It is happening with VR. The content producer has access to various distribution platforms, along with the monetization ability that comes with it. Again, you're still limited by the technological constraints.

But what's clear is that in this space, it's not necessary to have a big distribution platform behind you like a news network because it's still small enough and small-team driven. It's not institutionally driven yet.

Q. Do you see VR becoming institutionally driven at some point?

I can't imagine it's not going to be. The New York Times is behind it and Frontline is behind it — that's already a sign of it going that direction.

Q. USC has been known traditionally as the hub of film education, and now with the introduction of VR we're seeing an unprecedented merge between Hollywood and Silicon Valley. What are your thoughts on that?

There were tensions and there still are tensions. But it's been great for Los Angeles. I think LA is experiencing this surge of energy combining creativity and tech, and creating the strengths of media and the strengths of technology in a way that's unique to this community.

Q. Emerging technologies often act as a catalyst for social change. Do you see any opportunities arising for women and minorities to make a name for themselves in this industry?

In theory, absolutely. New technologies do offer opportunity for women and minorities because they attract people who are intellectually curious, who embrace the adventure of exploring new territories or new technologies! Those traits are not limited by gender, race or any other difference.

At the School of Journalism, our digital team, the professors experimenting with and teaching emerging technologies, is majority female and very diverse. Women and people of color teach coding, data journalism, social media and emerging tech, like VR.

That said, even with Nonny de la Peña being one of the critical thinkers and doers in the VR space, I do think that the tech world outside of academia is still male dominated and not as welcoming to women as it should be.

Q. What do you think needs to happen for that ratio to tip?

I think people are mindful of diversity and inclusion issues. So if a cluster emerges, with a little bit of visibility, opportunity follows. Back to education, this is why bringing these emerging technologies into our curriculum before they're fully baked actually paves the way for greater opportunity for women and people of color, because that's reflective of our student population. In many ways it's the educational process that creates the opportunity more so than the technological development process, which still tends to be in the male dominated province.

The current generation of students at USC is very diverse in all ways — from gender and orientation to ethnicity and race. By empowering them with the ability to use and deploy these tools for journalism, but also by empowering them with a sense of fearlessness about new technology, that creates a real opportunity for them and in the rest of their careers, whether it's VR or the next technology that comes our way. And if you're building a VR journalism unit, there are few places that train students better to do that than USC.

INTERVIEW: XING CHUNG, MINDMAZE (2016)

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*INTERVIEW CONDUCTED BY SETH SHAPIRO

FEBRUARY 2016



Xin Chung, Founder, Sofa VR was previously an executive at med tech VR company Mindmaze According to a spokesman for investor the Hinduja Group, “MindMaze’s next-generation human-machine interface is already proving itself in healthcare, games, and its potential for applications in transportation, defense and various types of media are now ready to be truly explored.” Prior to Mindmaze, Xin was a Founder of VRUX.co, TrustCloud, Botby, and Vykarian, as well as Chief Product Officer at Vinja.

Q. You’re a classic Bay Area tech founder – what brought you to med tech VR?

Xin: So my background actually is 3D animation. I was in visual effects and then 3D for games in a long time. So in terms of what I’m building, just so we have a little more fodder to play with here in the conversation, my job is to build the media subsidiary. We call it “media,” then it encompasses all things from any sort of immersive experience that you can have that can benefit from a neural component, which is what we’re bringing—these neural sensors and neural simulations that we can do to enhance. It’s pretty cutting edge in terms of what we’re working on, and bringing emotion and expression to the medium is another thing.

I’m a huge fan of social VR experiences. Maybe you’ve done the Toybox a few times with Oculus. If you’ve tried that, just the sense of co-presence is something that has stayed with me and driven the product roadmap direction that I’ve been championing at the company. So I definitely want to be involved in thoughts and conversations on how we can bring it with a very solo experience into something that is closer to another slide data, a true Metaverse avatar experience.

Q: It would be great to talk about sectors besides entertainment, because so much of the focus on VR has been around media. What are the implications for therapy and healthcare?

Xin: Maybe I can just define an arc for what the existing body of work is. It’s focused on the treatment of stroke victims – stroke rehabilitation through the use of virtual and augmented reality. So they interweave pretty traditional rehab techniques, that haven’t evolved in a long time, to include virtual and augmented

reality hardware that is sold to clinics, and doctors, and hospitals to rehab stroke victims in one-third of the time, that had been done previously.

They're going from tennis balls and wooden bowls to VR HMDs that take advantage of the brain's ability to heal itself – via neuroplasticity – and doing it in a way that keeps the patients engaged, it in a way that is much more measurable by the clinician. These are things that have been tried in the past, but the technology wasn't there to get the type of engagement that we have now.

So we have a couple products that are out, and we've finished clinical trials and certifications in Europe. And we've started working with folks like UCSF and Stanford in the States as we begin the FDA approvals over here for this clinical hardware, this med tech hardware.

Eventually that will move into over what we want to call “consumer wellness” for the masses, as opposed to the current system, which is for clinicians and stroke victims. It's pretty narrow in what it does. And we've been looking at how the wearable space has taken and reimagined different consumer-friendly technologies in the medical space, like transcranial direct stimulation. A couple companies that are doing that are cur.me, and Thync.com.

Those are examples of neural technologies that have found their way, interweaving with mobile phones to become consumer technologies.

So my challenge is to see how the core tech that we've done for stroke rehab can move into the media space. And it's not just media in terms of social VR, but also in terms of wellness, and further on down the road, we're looking at how we can make, how we can use some of our tech to get past some of the challenges in VR. One is, for instance, how long you can wear a VR headset, how comfortable it is in terms of experiences that kick in to get a response. Those are things that we're doing the research on.

Q. Can you talk a little bit about some of the broad therapeutic applications or areas in which this is going to make an impact?

Xin: Outside of stroke, there's any number of combinations of where we're using stimulation, different types of neural stimulation— non-invasive, of course, because those things that we're working on right now are non-invasive techniques on the scalp, on the forehead, on the face. And those simulations have been applied to, as you mentioned earlier, areas including phobias, depression, different psychological states that can be measured, and then, using a combination of VR and stimulating hardware to be able to affect that.

Q: Is there a particular therapeutic use that stands out as transformational?

Xin: Yeah, I would say that the stroke rehab, the existing one called My Emotion, that's one that is out there. In broad strokes, there's a correlation of just how deeply presence changes the treatments that are out there today. The treatments that are

out there today, they're out of context: they require a lot of effort from the patient. The treatments that we're bringing to market are able to keep the patients engaged, and are able to create, as much as the state of the art of that is today, is able to make that work better. The effect is an actual, physical change.

Stroke rehab is a really big market, and it's proven to reduce the treatment time. And also, people once thought that there was a window of which you could do that rehab. But as it turns out, the type of treatment that we brought to market, it can be done many months or even years after the initial stroke.

Q: So from your perspective as a serial what interests you most about this space?

Xin: I have to go to go to science fiction there because you mentioned Ready Player One when we were talking earlier. And as much as Ready Player One was about going and shooting spaceships, and casting spells or whatever, it was also about getting an emotional connection, a social connection with others in VR in a way that one wouldn't in the default world. There's the alt world and the default world, for example.

What excites me about this entire thing is that it's blending two: the most exciting types of technology together, and trying to get to a place that you see a brain computer interface that is so visceral, that is so low-latency, and that is so natural – that's what is most exciting for me. And tracking as much EMG data, EEG data, EOG (oculography), electrooculography which allows this to track your eyes similar to what the phone does.

Doing that and the fact that, for the time being, you have this piece of plastic on your face and a strap going around your head, until things get a lot smaller and a lot more fantastic – but these allow us to getting the sort of data that we couldn't get before, to drive neural forward. Because I was actually around in '07-'08, I worked with a company called Emotiv. I did a bunch of their game demos. That was an EEG headset that came out six, seven years ago for the first time. And the problem with that is that it was hard to create a condition where people would have this thing on their head. And you want to do it frequently and have a really clear reason to do it.

And with VR coming out of the gate this time around, super exciting, because now, people have it. They have it on their head, and all we need to do is embed the right sensors recording the right signal, and then dropping them into different experiences. I definitely am in the camp that regarding 360 video, that yes, it's nice and it's relatively easy to create, but it doesn't really have the depth. And I've been hard-pressed in the current batch of 360 video experiences to feel present.

So I think the premium experience, from a market segment point of view, the best analog that I can think about is the hardcore gamer, right? Which is not so different

from your gunsters running around in Ready Player One with their different rigs. Everybody's got the base rig that people are tricking out their rig to do the more awesome things. And it's kind of awesome that some of those things are happening now, and I get to work on them.

Q: Are there specific projects that you're a big fan of? Or on the other side, is there stuff out there that you think muddies the water, that for example, people watch enough 360 videos and then say "So what? This is 3D hype all over again."

Xin: You're exactly right. Okay, 360 video on a cardboard, the bar to create it is low. The bar to ship a million units out this early is low. So they went out and did it, right? Looking at that anecdote of what's happening right now. What New York Times did and what Vrse is doing right now, I think it's a great first step, but it hasn't been transformative for me. It may be transformative for some of the million people that got this strange cardboard thing in the mail.

So I think there will be a place for it. But for me, it is the higher end experience and the ones that have really worked for me, if I can say when my big sea changes were in VR as a backer of DK1, first was just the basic head tracking, like "Wow, this head tracking sucks," so that was the first one. The second one was actually getting hands into the situation. So people starting put Leap Motion in the front of their DK2s, so I did that, played with a demo called "Weight Lift," that was done by some guys that were interested in what the Leap could do for VR. And then most recently, the hands down at Oculus Connect in October, I think I did Toybox seven times, because it finally clicked for me.

The social VR portion of Toybox, the physicality of it, just the sheer presence of it was great. Even though you couldn't see the person's face, it wasn't even a proper avatar, it was just sort of a translucent head with disembodied hands was more present than with any top of the line Cisco, teleconference system, or Skype system that I've ever experienced, hands down. That there was very transformational for me.

What we're doing in terms of being able to create simulations, whether it be haptics, detect things, whether it be facial expressions, to empower that, I think that, at least for me, is something that's going to move this thing from being nice to have into the need to have territory because it is so powerful.

Q. What is the trajectory for social VR? How can VR become more communal?

Xin: You've probably seen the articles and know the names. The Phil Rosedale of the world and High Fidelity, the Altspace of the world, and then, of course, elephant in the room, Facebook, right? There are people creating the plumbing underneath. Google and Andreessen put \$25 million into a company called Improbable.io out of the UK, which is similar to High Fidelity wants to create the plumbing for the Metaverse. I think one phrase is "Second Life getting a second act," right? That's one way to look at it, and that's fine. Second Life didn't ever fully kick. It's still around,

it's still making money, it's still a couple hundred employees and it's doing its thing. But it's not Minecraft, right? It's not Facebook.

But when you begin to bring in the types of engagements and begin to look at where the money is and what the behaviors are of early adopters are, the segment that is willing to do this and spend their allowances or Christmas wishes on this stuff. Looking at Twitch for instance, right? So spectator e-sport, whether those seeing a game is as exciting or as satisfying as having stadium seating of a game, like "League of Legends," or a first-person shooter. It's still to be seen whether or not the visceral experience that one has of being courtside with a buddy, that's pretty important. If you're going to be courtside at a Warriors game, you kind of want to be with a buddy. I guess some people want to be alone, but there's a lot of high-fiving and hoots and hollering happening in that way, socially.

So if you look at what Twitch is, how fast it's grown, that type of e-sport spectator, you map a social VR data, an immersive, social experience over that, that's pretty exciting to me as an analog. And then as you mentioned earlier, all this stuff about narratives, and agency, and how that's going to play out, that's awesome, and I can't wait. I'm not really spearheading on that. I'm letting my friends like Neville Spiteri [of WEVR] see what they can see in that area.

Q. Do you think this is the year that VR breaks wide open?

Xin: As somebody that was around for VR 1.0, Virtual Boy, Dactyl Nightmare, all that stuff, the last time around and see it sputter out, the best crystal ball that I have is that your hardcore gamers say, I've heard the phrase, "I want so badly for this work, I'm willing to throw up." I hear that over and over. And I myself wanted so badly to be at "Half Life 2" in VR that I made myself nauseous. It took me an hour to recover. I wasn't throwing up for an hour, but I was nauseous, right? I took the headset off and I just went about my evening. I was like, "Goddamn, I feel shitty." That's how badly I wanted it to work.

So that being said, I think you're going to get plenty of hardcore gamers pick up a high-end rig this year. I was a huge fan of Gear VR. I think they've got a nice lead right now. I'm going to call it the "Big Four," to include Google in there, PlayStation, as they do, will create their own ecosystem and do the walled garden thing, Oculus, not the least of which is they've got a great team and beautiful hardware, and we're getting a first version in a month, possibly, will be what my eyes are on for the high-end.

I have some concerns about HTC. I finally spent a lot of time with a Vive in a quiet room, the very latest Vive in a quiet room. Lighthouse is noisy. That's not something you want to have running for any amount of time in your living room. It's like a really loud air conditioner. I'm like, "Okay, that's kind of a bummer."

And then Google, of course, it leaked out that they're working on an HMD that doesn't require a mobile phone or a PC. So I assume that they're just going to take and just embed some sort of Nexus model into an HMD.

I guess my final thing is I said I'm bullish on the Gear VR. But you've also heard the adage that people are going to be throwing their Samsung phones in the freezer before they go in, right? So I think they're acceptable growth pains. Is it going to be explosive this year and this Christmas enough to have a foothold that it's going to break loose? But is it going to go iPhone 2009? Is it going to go iPad 2012? Less likely. We're not going to see that sort of explosive growth. There's just not enough there.

But I don't think the foothold is going to break free. And I think gamers first, which is absolutely fine, and then it will move into the experience, the immersive experience. After the gamers are done doing their stuff, and Mom comes over, sister comes over, what happens then? And that's what I'm most excited about. And as I said, I think a lot of that is on the social side.

INTERVIEW: CHRIS EDWARDS, THIRD FLOOR (2017)

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*INTERVIEW CONDUCTED BY SETH SHAPIRO

APRIL 2017



Chris Edwards is Founder and CEO of The Third Floor Visualization Studio. The Third Floor is the world's leading visualization studio, contributing to the majority of major studio-based entertainment projects throughout the world— using the virtual world to imagine, plan and problem solve for stories in film, television, games, VR and themed attractions.

Background

I grew up as a fan of classic Hollywood cinema. When I was young, my parents took me to a lot of film festivals, where I saw some of the best cinema that had been created to that time.

And I was really inspired by Roger Ebert live at a film festival in Virginia. He showed me the power of cinematography and film language through the eyes of Gregg Toland and Orson Welles and Citizen Kane. He screened the laser disc of Citizen Kane— and pointed out over the course of three days, shot by shot, how the composition and other cinematic elements shaped the emotional impression on the audience.

It was an epiphany for me: that there's a lot more to cinema than what meets the eye. And so I went on a lifelong pursuit of this. Also, I wanted to combine it with the other side of my training, which is from my dad who's an aerospace engineer, a rocket scientist. He trained me on how to use computers, and early forms of computer graphics.

So I knew that there had to be a career out there that would combine computer graphics and classic cinema. But at the time it didn't exist.

So I went to film school with a dream to someday work with George Lucas and Steven Spielberg. I went to film school at the Rochester Institute of Technology, which is the home of Kodak. I learned about making films there, and about animation, but none of that had anything to do with computer graphics. Computer graphics was my hobby.

Origins of Previsualization

Every summer I would go to different internships to learn what was then the cutting edge: Silicon Graphics (SGI) hardware and software. That was my crash course in computer graphics, which became the basis of my student film, a 3-D, pseudo-Pixar short film that became my

calling card.

The film caught the eye of Disney Feature Animation, and got me a job on a 3D animation project, Disney's *Dinosaur*. *Dinosaur* was a breakthrough project at the time. It had live-action backgrounds in exotic islands, including Hawaii, to which computer-generated dinosaurs were added.

But in order to plan where the dinosaurs would go and how wide a certain shot should be, and how the camera should be moving to cover the action of the theoretical dinosaurs, we needed to figure out what to shoot.

So that was the genesis of previsualization for me.

I went on to become a lead layout artist and animator at Disney Feature Animation. Over five years at Disney, I worked my way up the ranks and became a lead 3D layout artist. And I used that experience to get my next job and pursue my next dream, which was to apply what I'd learned to live-action filmmaking.

The Third Floor

I knew that computer graphics would give filmmakers the ability to design shot by shot, sequence by sequence, in some cases, across entire films. It would give them a huge advantage.

But with visual effects, one needs to work in layers, and to plan in advance. And that became the origins of the modern previs industry. For me, that began 15 years ago, when I joined Lucasfilm, on the third floor of George Lucas' Skywalker Ranch house.

We had a small team brought together to support George Lucas on *Star Wars: Episode III: Revenge of the Sith*, and later Steven Spielberg on *War of the Worlds*. This small team forged a more sophisticated process than anything before, designing every shot for *Star Wars*, many times over—approximately 70,000 shot iterations by the time we were done. It was the digital blueprint for everything in the movie.

And after our two-year tour of duty at the Ranch, I led a majority of the folks there to join forces, and create our own company, called The Third Floor, Inc.

We went from the San Francisco area to Los Angeles to set up shop and cultivate a presence in the film industry. I worked a second job at Sony Imageworks, on animated features, to fund our operations. In the evenings, I was a previs supervisor at The Third Floor, where my co-founders and I began to establish our reputation for the highest quality previs.

And about thirteen years later, I'm proud to say that the process of previs is almost universal. It's been adopted by most of Hollywood, including almost all large-budget, effects-driven features.

Teams at The Third Floor now touch over 75% of Hollywood blockbusters each year, including many of Lucasfilm's projects and almost every Marvel production. We have contributed to the past four seasons of *Game of Thrones* and major theme park attractions, like The

Wizards World of Harry Potter Gringott's Ride, Fast and the Furious Supercharged and Despicable Me: Minion Mayhem.

And coming full circle, we're so proud to work on many projects within the Disney universe.

What's so exciting now is the proliferation of pre-vis tools that are increasingly real-time. So we can iterate with the creators and designers on the fly, and change literally any aspect of the vision, before it becomes the final visual in the movie, game or theme park. We are very excited about the promise of accelerated virtual production techniques—literally the process of creating media of all kinds by allowing the filmmakers to step into their creations.

And we can apply these techniques across film, television, themed entertainment, games, and VR. And we're increasingly getting involved, as a studio, in talking about the best ways to make transmedia launches for major film franchises.

VR and Previsualization

We initially had the thought to use VR as a tool for filmmakers in virtual production. By virtual production, I mean films like Avatar, Gravity, The Jungle Book, etc. These projects are largely digital, and require a live collaborative effort using computer graphics on stage or on set.

Then as VR headsets became more advanced, it became possible to put directors and production designers inside the sets being created—so that they can feel the world all around them, and change anything. We started using that on Miss Peregrine's Home for Peculiar Children with Tim Burton, and several other projects since.

And then there's the second big promise of VR, which is really the bigger surprise for us, which was that VR itself was adopted so widely by technology companies, distributors and digital network providers.

Since we're already working on motion pictures creating previs assets that are essentially video game assets—we thought, "what if we can use those assets, repurpose them, to create bespoke VR experiences, that are additive to the film? At the very least, they can be used as advertising. Or they can be a completely transformative extension for audience engagement beyond the theater.

Location-Based Entertainment

We're excited that this dovetails nicely with what theater owners are attempting to do: upgrades to multiplexes, fancier seats, better food, more of an entertainment destination. This trend can also incorporate custom VR experiences in theaters, as another option for motivated moviegoers who want to have a deeper engagement with the movie.

The consumer adoption of VR technology will have a steady escalation. It's going to take some time for consumers to be willing to buy the right computers and headsets, and to have the expertise to set them up at home. So we are big believers in location-based experiences, experiences at Family Entertainment Centers (FECs), malls and theaters.

These locations are the best places to experience truly high-end VR experiences.

And we think it's important to make sure that early adopter VR audiences get the best quality experiences. The best way to get them excited in the short term is with these premium experiences, which will in turn increase the chances of them buying their own VR equipment in the coming years.

The Third Floor and Semi-Interactive VR

We're privileged to have worked on notable recent productions like The Martian VR Experience, which was a collaboration between The Third Floor, the Virtual Reality Company, and Fox Innovation Lab. It's based on the amazing film The Martian, directed by Ridley Scott, and allowed us to create an experience that was part-movie, part-game. It takes audiences on a journey through some of the key moments in the movie, in which you play the part of the lead actor, Matt Damon.

We were able to publish the title on all three major platforms: Oculus Rift, HTC Vive and PlayStation VR and worked hard to make the interactivity very similar for all three vastly different platforms.

And now we're forwarding that experience into projects from storytelling episodes, all the way to theme park attractions requiring VR implementation.

It's just an exciting time to be involved. And we're excited also to be working on the content side, because it's often a matter of starting early enough to create truly meaningful cinematic VR experiences.

VR, Cinema and Games

VR is an important step in the history of cinema. It's really leading a lot of directors and storytellers to rethink the medium that they've known for so long. And there's an excitement, sort of an arms race, to determine what are going to be the most popular genres and techniques in VR.

I think we're going to look back at these first five years of this stage of VR exploration and be stunned at the number of advancements: from the development of hardware and software, to the great work of creators, to the new language that's being developed. So we're excited to be part of that wave.

In some ways, VR is the product of the games industry and the film industry... and we're right in the middle of the baby that they've made: VR, and soon AR.

If you look at the film side of that spectrum, it's what we call a classic narrative: it's the same movie every single time. Then on the game side of the spectrum, you have a large audience of younger gamers. They want a completely open world of multiplayer experience, where they immerse themselves in an environment, and come up with their own story.

We believe the largest audience for VR is right between those two areas: an audience that wants to go beyond the classic passive film—but are not going to the other extreme. They're

not going to want to create a personality, set up an avatar, gather their friends, etc. It's too much work.

Right in the middle is what we call the semi-interactive narrative VR experience. It's still based on a story, and there's something hypnotic and engaging about it, but at times you are invited to participate in and influence the story.

This is also referred to as "branching narrative": the "choose your own adventure" model. We're excited to use our skill sets to help directors understand the potential of this new medium, and how to adapt their stories to utilize this medium, where you can invite the audience to become a part of the story.

This is certainly a challenge, and something that requires technical proficiencies many directors, scriptwriters and producers do not have. So our business plan for The Third Floor is to create an engagement with creators. We provide a sandbox for creators to iterate on their ideas, to use available technology to create interactivity without too much of a focus on the technical challenges.

For VR experiences, we use a similar process to the one we use in film. It starts with a brainstorming session: about how each sequence can be made more emotional, more effective. We're not thinking too seriously at this point about technical limitations or even budget. We're trying not to limit the idea, or to shoehorn it into a box. As the production continues, we get more serious about how we're going to execute, so that it can be achievable and done on budget and in time.

Augmented Reality

I think that the promise of VR is going to be furthered by AR. There are several dark horse companies brewing up new hardware that will be even more widely appealing to consumers because it will be based around practical, everyday applications.

And that is what AR is going to allow. It's going to make our daily lives easier. Over time, we think that VR will be an extension of the AR toolset, so that you can go from the VR mode from your AR device and experience a form of entertainment when you're in the mood to do so, as we do with our phones when we're traveling.

This has already begun, but we think that it will be accelerated quite aggressively over the next several holiday seasons. The number of verticals that can be helped by this technology is enormous.

Technology and the next Generation of Storytelling

There are a lot of inspired creators that can really benefit from our expertise in particular and from the previs process in general. My hope is that we can get this message out: that visualization is no longer cost-prohibitive for independent films or smaller projects.

In fact, smaller productions sometimes benefit the most. They need to save money, to be very strategic about where they spend their resources. So previs can help these creators as much

or more than large-budget feature films.

I feel like new creators should work across the landscape to VR, too. I think many people think the learning curve for VR and is quite high, or that the tools are out of their price range.

But I beg to differ. We've walked through some of the early challenges. We've learned enough to be able to do surgical experiences and really cost-effective VR storytelling, that can be really affordable.

It's such an exciting time to be a creator. You have the ability to take a dream and place it in visuals affordably. You can get it to an audience through the Internet. Little guys have a much bigger chance than they used to. There are social networks and online distribution now, and all this is playing into the future of media in general.

Lastly, I would say to anyone entering the industry now: don't be daunted by change, be excited by change. See it as an opportunity: to get ahead of the curve. We do, certainly.

INTERVIEW: ROBERT HERNANDEZ, USC ANNENBERG SCHOOL FOR COMMUNICATIONS AND JOURNALISM (2017)

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*INTERVIEW CONDUCTED BY PERISA BROWN

MARCH 2017



Robert Hernandez is an Associate Professor of Professional Practice at the USC Annenberg School for Communication and Journalism. His primary focus is on the intersection of informative reporting and storytelling, aiming to engage people in a community setting while broadening his reach through different forms of distribution. At Annenberg, Hernandez has been a pioneer in training the next generation of VR and AR content creators. He and his students produce VR experiences under their brand:

Background

The first AR class I taught was in 2013, which was AR Journalism. In total, I've been at Annenberg for seven and a half years. I spent about three years of doing core-classes, then I taught a coding class, and then I taught this one. I had been going to AR conferences for a few years before I put the class together. My specialties are emerging technologies and digital storytelling for journalism, non-fiction storytelling.

So what we ended up doing was augmenting the LA Public Library. We worked with the library to augment the space and to tell stories from a different perspective. You can download the app on iTunes: ARchive LAPL.

To do AR you need a marker, or GPS, or facial mapping, so we ended up using physical objects as our visual markers. We used the Metaio platform for that.

Basically, there's a torch in a hallway, and when you launch our experience and point at the torch, it has buttons overlaid on it because in the 1980s there was a fire there that changed the city and changed the library. So there's a video piece that we did and a photo gallery of the fire. There's a kids section as well, in the back there's a puppet's stage. The library puts on a puppet show every Saturday at 2pm, but if you miss it, you miss it. So if you point the device to the puppet show stage, it overlays a magic window of a puppet show that was pre-recorded.

There are a whole bunch of different ways you can use this. We also had access to special collections, so we made 3D models and created these book markers to show things like the original printing of Ulysses, and my favorite one, which is Edgar Allen Poe's The Raven illustrated in a gorgeous book. So you look at the model, you can tap on it, and a photo gallery pops up so you can flip through the pictures.

Q: So your class is set up like a mentorship, where you train your students they go out and create projects?

Yes my classes are kind of like a hack-a-thon style class.

Q: When did you venture into VR?

So I did AR Journalism in 2013, and then I did a class based on Google Glass and wearables, and then I did VR, which I've been doing for the last two years. This year I'm completing my fourth semester teaching VR. When Google Glass kind of nose-dived a little bit, Oculus was on the rise, and what got my interest was Samsung Gear.

I saw opportunities to create stuff, so I created a VR class two years ago, and from that I was approached by the news organization ProPublica. We went to Houston during spring break and did a piece about the Houston ship channel. We did a 360-degree production, where we merged CG and 3D graphics. We also launched an app which is on iOS and Android, called JOVRNALISM. After that, we worked at the Center for Investigative Reporting, Reveal News, to tell stories about the drought. In January this year, I took a couple students to Washington D.C. to cover the presidential inauguration and the Women's March. We worked for the New York Times and NPR and published our own pieces there. This semester we went to the Salton Sea. We worked with The Desert Sun and we're in the middle of production for immersive stories.

The class is a hack-a-thon where I bring student from across the university — obviously, most of them are going to be journalism students because that's the school the class is offered in — but we've had students from gaming, engineering, cinema, etc. The vast majority of students come in without any experience producing content for VR.

Q: So you teach VR production from the ground up?

Yeah, but it's not like I'm going to hold your hand and teach you "this is what we're going to do." You learn by doing it. The framework is usually a media partner and a topic, which in this case was The Desert Sun and the Salton Sea. So then The Desert Sun would come with their reporters and tell us about the Salton Sea, students would listen, and then pitch ideas of how they can tell immersive stories about the Salton Sea. Once an idea is picked, then the rest of the semester is spent figuring out how we're going to tell that story.

We did a variety of different experiences. We also did a story on Ebola. Ebola was the news story at the time — it was moving fast and there was a lot of misinformation. So we created an experience based on that to better inform people about the issue.

That's interesting that you were able to alleviate some misinformation by using this technology. Do you think that showing a situation through a 360-degree view gives people an inherent sense of transparency and authenticity about an issue?

It does and it doesn't. Just like anything, I can put it in such a way to manipulate the scene, so it's just a different way of doing it. It doesn't solve a problem. Some people think "Oh my gosh, in CG you can make up anything. Here come more liars." That's why I want journalists and ethical storytellers to come in to play to tell these stories. That's why we're working on these things at Annenberg, to help define what these things are.

Anything you can come up with, you can manipulate, so it's not "either/or" with VR and transparency. For journalism, it comes down to credibility, my track record, if I've earned your trust and if I can retain your trust. It doesn't matter what platform you're on — you lie in text, you can lie in video and you can lie in CG. So that doesn't change, but there are things to be more aware of.

There have been some studies that indicate a new level of thinking that journalists often don't think about, which is the level of responsibility about how effective this information or story can be received. Experiencing certain stories in an immersive way brings a new level to their impact, and we need to figure out that responsibility of when is something too traumatic or when do we induce trauma. We don't want to shy away from important topics. Even if something's offensive, people need to be aware of it, so these are new things for us to tackle. That again is part of the class and what we do here.

Q: Do you think there's a fine line between tact and offensiveness in using VR for journalism?

It's just like anything. I can show you a live video of something that is not tasteful, that is offensive. There are live streams of horrible things. These are just tools. I always give the analogy of a telephone: you can judge the technology of a telephone by the conversation that a 12-year old had on it, or by a conversation done by the president during wartime. It's the same device but used with completely different levels of importance. So in the end, it's just a tool.

It's up to us to think about that. You could totally do it wrong. You could use journalism to cause harm, but you can also use journalism to talk about some really tough issues.

Q: I've heard this comment from a lot of VR content creators: "If you can think of another way to put content in front of people's faces, then you shouldn't make it on VR." Do you agree with that?

Somewhat. You want a threshold to justify that you're doing 360 for the right reasons. Early on I would say that you have to experiment. But there's a difference between experimenting and publishing. You have to figure out what makes a good shot. So, experiment now to figure out what a good story is using this technology. The technology will get better down the road, but you have to experiment now and

know that if it's not ready, then don't publish it. At some point after you've done these experiments and figured out what works and what doesn't, when someone approaches you with a story idea you can make something competently.

Ideally, you want VR to be exclusive to those kinds of experiences, but it depends on what your metric of success is. Is it how many people you reach? Is it how long they're in the experience? Do you want them to share the experience, or to think that's the best experience they've ever had? It can be any of those things.

Q: Having experimented with different methods of content creation in VR, have you come up with any best practices?

A lot of things I've learned are how not to shoot in 360. With us, our output is for mobile devices because we want to reach a larger audience, not just the audience that can afford a head-mounted display. So we make a series of compromises because of that, but in doing so, we merge 360-degree videos with traditional photos and videos. We also bring in CG graphics and I think that takes advantage of the immersive space. That also gives you more options to play with as opposed to just holding a shot in 360.

INTERVIEW: AARON KOBLIN WITHIN (2016)

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*INTERVIEW CONDUCTED BY SETH SHAPIRO

JANUARY 2016



Aaron Koblin is a prolific data artist and the co-Founder of Within (formerly known as Vrse), with Chris Milk. We first met when he was Creative Director of the Data Arts team at Google's Creative Lab, where he led a series of groundbreaking projects including brilliant The Johnny Cash Project and Arcade Fire's The Wilderness Downtown. Within is a leader in Virtual Reality experiences, delivers the Best Overall VR Experience on iPhone, and was the lead content partner for The New York Times' landmark VR/Google Cardboard launch.

Q: What was it about VR that got you to leave Google to found Vrse?

Aaron: Chris and I had been talking for quite a while about the potential for VR, as many have. The billion-dollar question was: "When is there going to be hardware that people can actually get their hands on, that will allow for creating the kinds of experiences we've been doing for a long time – but now distributable to a larger audience, in the real world?"

For me, it was about the impending devices on the horizon – and the fact that we were actually going to be able to at least experiment with a lot of things we've been dreaming about for a long time.

Q: What do those things look like?

Aaron: Chris and I have been thinking about how you use technology for creating art, to connect deeply with people. The way we've done that in the past has often used crowdsourcing to get people to work together: through the Internet, experimenting with personalization, where we can tailor an experience that's specifically going to resonate with somebody's memories and experiences.

And also, general interaction... thinking about installation and physical status – how that affects you very differently from seeing something on the screen. We've both done installations that are in museums, large-scale things. We've played with things like bass and deep sounds that actually affect your body, and large sculptures in the sky that you can interact with. The pure scale of these has a deep impact.

I think the opportunity of VR is to enable these kinds of things, to be able to mix them and combine them. It's also to allow people to experience them in the comfort of their homes, which is something we have never experienced in the past. We can have that sense of presence, and actually being there. You can also have tailored experiences, and interactivity, and connectivity with others... all these things where you're basically hacking your senses with VR – convincing you that you're somewhere you're not.

And that somewhere that you're not can actually be someplace that doesn't exist, and couldn't exist. You can manifest anything that you can dream up.

So that's basically the concept. This is an amazing opportunity to begin to forge what this medium means, to establish a few best practices, and a mix of rules that can be broken. This is probably a once-in-a-lifetime opportunity to help define what this medium can be. I think that was what really threw me into it.

Q: What makes this a once-in-a-lifetime moment? Is it the notion of defining immersion, or presence, or agency, as opposed to the more passive POV that we're used to in media?

Aaron: Yeah, so I think there's a temptation to think the presence as a binary thing. A lot of people are saying, like, either it happens or it doesn't happen. And I understand that temptation, but I actually think presence is more of a gradient. When I think of presence, there's the physiological version that is basically: I truly believe that I'm somewhere else. And even in VR now, the way it currently is, I don't think anybody would consciously evaluate where they are and decide that they are somewhere that they're not. You still know you're in VR right now. And I think really what I'm more interested in is presence as it relates to what I think of as flow.

So if you're in a great computer game, and it's really immersive, you can actually achieve a very low level of presence through that screen. Basically, I get lost in it. I'm immersed in it and forget about everything else around me, and I'm having this amazing experience. With VR, it takes it to the next level and kind of forces you into that state, or at least enables you to get to that state in a much quicker, easier way.

To me, presence is about those moments where you just forget that you're not actually in this place. You're really in the moment, and you allow everything around you to be what it is. I think it just becomes very easy when you have both visual and sound. I think we often forget what an important role, a crucial role sound plays in convincing you that you're somewhere, and having the sounds react relative to where you're looking, and have the dynamics that you expect from the space that you're occupying.

And then there are other things that are happening in the space, where people add an additional dimension. At some events, such as a fan or heat source – something that plays into the experience and validates your subconscious expectations, really helps take you to the next level. It's not an incremental thing: it's an exponential thing.

So there's actually a group in London that aligns these events with time code. They actually create physical sensations to align with their films – so if you're on a soccer field, they have a handful of grass that they put underneath your nose, and if they have a scene where you're in the kitchen, and they have a heat source that they turn on when you're near the oven.

If you take it too far, like sometimes happens in Southeast Asia, where they sometimes have a snake that comes out under your chair, that's cheesy and takes you out of the experience. But anything that doesn't take you out of it and supplements and reinforces your expectations is really effective at taking you even further into presence.

Q: So an example would be the use of the fan and a faux wire in The Walk VR – to simulate what you'd feel like walking a tightrope between the World Trade Towers?

Aaron: Yes, exactly, where you just really feel like you're out on a cliff, because you have that extra sensory input for this sensation.

Q: What's the dance between the tech and the creative for you? This is chicken-and-egg... but do you generally conceive of a vision for a project, and then find or create the technology to achieve it – or are there breakthroughs in technology that then inspire a creative leap?

Aaron: It's definitely an interactive process, so we're learning what's possible and then experimenting and building on that. We're definitely a story first company so we think about, "What are the amazing experiences and narratives that we can build upon to create something that will deeply connect with somebody?"

So there's kind of two schools of thought in VR right now. One is what's called the real-time rendered camp, when you start with interactivity, with maximum flexibility and responsiveness, and then work towards photorealism.

For now, we're approaching it generally from the photorealism side, where we think people really connect with faces and places that are very real to them. And then we're working towards the interactivity side, and looking at things like branching narratives and other ways to add interaction. But, for us, the real power is right now on the story side, and on the connection side, and on the ability to create experiences that we see as, hopefully, timeless rather than timely – things that are going to hold up despite the fact that they'll be technically embarrassing in the not-so-distant future. The content itself will hopefully shine through and still connect with people.

Q: Tell us about Vrse and The New York Times Google cardboard project.

Aaron: Yeah, the New York Times Google Cardboard giveaway was a huge moment for VR. I think it immediately got a million people into headsets and kind of helped to cement its place in culture. I think that those brands obviously have a lot of attention and a lot of significance in society, so I think them coming out and making

that statement, and making that gesture, and making that investment was really significant.

And we were really proud to partner with them and work on the content with them. I Chris can speak a lot more to the history of the relationship, but working with Jake, Editor of New York Times magazine, was great. I think Chris and he clicked instantly, and had lot of ideas for ways that this technology could be used for journalism. So we've partnered together on a number of different pieces already, all of the first pieces that The New York Times worked on.

Q: As you know, I'm a big fan of your work at Google, especially The Johnny Cash Project and The Wilderness Downtown. Was there a throughline between the stuff that you were doing with them into Vrse?

Aaron: A lot. I think in many ways what we've been doing for the last decade is to build up and related to something we're trying to do now. It's about using pixels and mice— or pixels and digital input devices— to enable people to have an emotional connection with something and have an experience that is taking them somewhere else. I think that's functionally what we are. It's, "How can we dream up spaces, and places, and ideas and find a way to get people there in a significant way in order to connect with them?" So I think, specifically with those examples, you have the ideas from Wilderness Downtown on a lot of about interactivity and personalization and how can you create an experience for somebody.

And I think we haven't really seen that in VR too much yet, but I think it's coming— especially as we build on technologies like artificial intelligence, and we tap into other types of databases and responsiveness. We're going to know things about how you're interacting. We'll probably begin to know things about who the players are, who the users are, and that can be used directly in the content itself, I think, in meaningful ways. Similarly, with Johnny Cash, I think that idea of community and creation. We've already seen the explosive power of things like Minecraft, and in VR, I think you're going to be able to share those spaces in even a more convincing way, and it's going to lead to all kinds of creative tools and shared creative capacities, and people will make amazing things inside VR.

Q: I think everybody in this space had a moment where the light went on – where some experience made us think: "This is it. This is a quantum leap in the nature of media experiences." But we're obviously not at critical mass yet, and there are a lot of questions about what will get us there. What do you see are the things that are likely to make this space catch fire with the larger audience?

Aaron: There are several ways to answer that question. There's the hardware side which is going to continue to develop, and it will guide a lot of the way the industry unfolds. I think the mobile stuff is going to continue advancing, and will likely be the way that majority of the planet experiences this kind of content.

There are a bunch of big questions about which aspects get there first, like if we can get to a point where, let's say, fiber explodes. One can imagine a world where

people wear VR devices that look more like dumb terminals, and we could stream down content, low enough latencies that that could be game-changing. The way that fiber really runs so far, it may be a while before we can get low latency connections to enough people, but I think the mobile side of it is probably going to advance significantly in other ways as well.

You're going to have things like Google Tango, which will be built into the coming mobile phones, which will give similar functionality to what's in other headsets today – but in phones. I think you'll also get phones that have full spherical cameras built into them. That won't be the same as VR necessarily, or the stuff that we're trying to aspire to. But you'll be able to get immersive panoramas that will have personal significance, because you can record your own events, and your own family, and your own friends, and that's an amazing experience not many people have had yet.

It's kind of like looking at VR footage of people's own lives, from a third-person perspective. That's something Chris and I have just been experiencing for the first time, and I can tell you it's very strange to have that kind of out-of-body experience with your own history. I think that's coming for a lot of people.

And if you look at what's happening with those high-power headsets, gamers are going to make the investments that are needed to really advance that next level of immersion and interactivity. So I think that'll be leading the battle cry for sure.

Q: When we look at back in 10 years, what is 2016 going to be remembered as in VR?

Aaron: I think it's going to be the year of the launch.

Q: Of HMDs, or generally?

Aaron: All of this is coming out for the first time. Yeah, other HMDs are coming out for the first time, and people are going to take it a lot more seriously. But I still think it's going to be a little while before we see true kind of mainstream adoption. It's so hard to say, because we really haven't had a moment like this throughout the course of human history.

There have been media types launched and huge technological advances, but it feels like there are huge unknowns this time. There are many companies putting significant amount of money in, and all the eyeballs are on these launches. So it could be the case. We already see an acceleration in the process, and workflow, and thinking, completely unlike any other mediums we've seen. History of cinema taking a hundred years to really reach maturity, many argue, and we're kind of running, skipping, and jumping through a lot of the baseline limitations.

But will there be a bit of a gap between the initial launch and the sense for adoption? I don't know. It's still hard to say. It's still going to be expensive for your average consumer, so it's going to be very much gaming off the bat. And then I think it's going to continue to be refined and developed, and there's going to be significant

advances before finesse versions come out, and those will probably be the ones better, even more mainstream, I think.

But TBD. It's also that huge question around kind of the theater-style/theme-park-style versions of these headsets. So it may be the way that people get access to them for some time. And also, on the international side, I think, the mobile thing is going to be huge, and it's possible, I have no idea if this will happen, but I can imagine a scenario where there's something akin to an Internet café.

You mentioned this feeling like the early days of web browsers before. Everybody keeps thinking about it as theaters where people go and put on 3D goggles for VR. But it might actually end up something more like an Internet café where you go and have access to VR goggles for an hour or whatever it turns into, or you pay by the hour to use them.

Q. What do you think of the notion of location-based VR?

Aaron: I'm personally very interested in it, I think. It's a very compelling and engaging experience to have the real-world aspects, where there actually is a wall there, where you feel like there should be a wall there, and you're actually holding an object that resembles the object in virtual space. I do think there's huge potential for that, and I wish that I grew up in a world where there's that kind of entertainment –things like that will be incredibly fun. But, yeah, I think there may also be a world for physical objects for the home, like gaming objects that resemble objects in the game. But that could also add that extra level of reality to the physical-virtual pairing. We'll see.

I think, first, what people need to do is like solve the chair problem. There's going to be some kind of device that gets made that's slightly better than a swivel chair in terms of weaving, and moving, and potentially transforming into a bicycle or motorcycle or a hoverboard. But the natural physical movement thing is a big issue, because you're always constrained by the reality that you're in. In virtual reality, you want to go everywhere, so we need to come up with a paradigm and language to allow people to traverse large spaces and then have local explorations along with that. So I think there's going to be some interesting chairs and peripherals that come out of this world.

INTERVIEW: YELENA RACHITSKY, OCULUS (2017)

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*INTERVIEW CONDUCTED BY SETH SHAPIRO

APRIL 2017



Yelena Rachitsky is a Creative Producer at Oculus, pushing forward the efforts on creative outreach initiatives and finding and funding Experiences for the Oculus platform. Prior to Oculus, she was the Creative Producer of the annual Future of StoryTelling (FoST) summit, an invitation-only event that gathers top executives, marketers, creatives, and technologists with the vision and influence to change how people communicate and tell stories in the digital

age. Rachitsky is also a consultant for the Sundance Film Festival's New Frontier program and spent four years in the documentary division at Participant Media, working on *Food Inc.* and *Waiting for Superman*.

Background

I was born in Russia, and started off my career in film. My friend's dad was a DP for documentaries, and I thought, "Okay, that's interesting." It filled a lot of the buckets that I was interested in. So I started working in film, and jumped to Participant Media, which made social good documentaries—including *An Inconvenient Truth*, *Food Inc.*, and *Waiting for Superman*.

And a lot of these films were started from the stance that stories can really create impact, affect people emotionally, create a deeper understanding of something they didn't know before, and possibly change the way that they act and live.

I was there for about four years, and I started getting introduced to more technology-driven things. And I started to feel like people were having similar conversations, and in some cases doing things in the same kind of way, living in a bubble.

Then I went to Sundance and stumbled on New Frontier. At that time, it was down in the basement and was mostly made up of interactive installations. And being immersed in these large installations gave a different kind of feeling to an experience...more experiential than a specific plotline. That left me with a feeling that stayed with me.

So I started digging a little further, and came across the National Film Board

of Canada, who have an interactive site. They've been putting funding towards experimentation in interactive storytelling for over a decade now. And they had some really interesting stuff there, including one seminal project called "Welcome to Pine Point", which is minimal in interactivity but has a really compelling story, and enough agency so that I really felt like I was creating my own experience that it took me through.

That was the first inkling for me of, "Okay, this is interesting. People are using technology and starting to explore space," and then I just started getting deeper into it until I was like, "Okay. I just gotta jump. I gotta leave [Participant], and I've got to figure out what this whole space is." So I left, with no other job, for an inspired but poor two year of my life!

Then I dig deeper into what everyone was doing: at Tribeca, at the IFDA Doc Lab in Amsterdam, understanding what people were experimenting with: production mapping, people hacking connect sensors to create interactive installations. Learning more about interactive web-based stuff... The New York Times came out with "Snow Fall" which was kind of a seminal piece for them, even though it was so minimal on interactivity. All these different things and different topics.

And serendipitously, as I was looking for what my next thing was, someone said, "Sundance is looking for someone to oversee the New Frontiers story lab while the new person is on maternity leave." It was a perfect segue, so I jumped in and it was the perfect space for deep exploration, of seeing and understanding what people were making.

But there was still just no distribution strategy for it, no way to really share the work. It was still very vague, and people didn't really understand it. But it was also really fun because you're kind of the weird kids in the corner!

So then I moved over to helping program for the New Frontier exhibition at the festival, which was great. I did that for a couple years and that's when the Kickstarter campaign came out for Oculus. And someone's like, "Hey, look at this."

And I was like, "Huh, that's interesting." So one of the producers and I went down to the DK office in Irvine, where I think there was one Rift station in the corner. DK1, one PC, just a bunch of guys... obviously way before the Facebook acquisition.

And I tried a couple things. One was called VR Cinema, where you're in a theater by yourself, watching a movie. It was similar, if you think about it, the beginning of film, where they basically put a camera on a live stage play. And I'm sure if people back then, were probably thinking, "Oh, that's amazing. I'm able to watch this in a different space."

So it felt like that moment—where I was in a stage movie theater watching a movie, before they started making work for the new medium.

So we programmed Oculus at Sundance that year and we had about four pieces: Chris Milk's Beck 360 piece Sound and Vision (which started as a web piece and then was ported to Oculus), Clouds, VR Cinema (showing the short films at Sundance), and one of the early games.

And that year, I was also programming the panels and conversations. We had one panel on The Future Of Storytelling, with Nate Miller and Chris Milk and a few other people. And the question was, "What is going to be the future?" And the answer was, "Virtual reality."

It was fascinating. That was the pivotal year at Sundance, when the broader film community started paying attention to New Frontier at Sundance, and the word started speeding about this new interesting thing. Storytellers started to see the implications. It was an exciting time.

After that, I started working on the Future of Storytelling conference, and moved to New York. So that was a time of very broad thinking about storytelling in the digital age—the psychology, the marketing, the technology. And it became more apparent to me that this all led to VR.

VR is the compilation of everything. It's projection mapping, shifting a physical space around you, where you feel like you're transported somewhere else. Now you don't actually need to go to a physical location to experience that. And you can create interactivity within a VR pieces—which web-based stuff was doing for interactive storytelling... but VR is actually better for that. VR creates that space for you to really be focused and inside.

So after more exploring, I decided that I wasn't going to do the traditional documentary. And then I jumped over to Oculus Story Studio, and focused solely on virtual reality.

And that was exciting, because the past couple years have been a very exciting time in VR. And part of that is because lots of people who were doing different things before are jumping in VR now. You have really smart, forward-thinking technologists. You have creative artists. You have creative game makers. You have filmmakers, storytellers, and writers. There's a convergence of great talent putting their minds together, collaboratively, to come up with new solutions. Which is somewhat as opposed to film, where people often feel like they already know the answers. There has been real spirit of innovation in VR.

But I'd say until last year, there was still a question: "can you really tell a story in VR?" And Oculus Story Studio was put together to answer the question.

Henry

The first experiment was Lost, which had minimal storytelling but paved the way. And that pushed forward to Henry, which was much more of a three-act

storytelling structure.

And then as you know, now we're seeing an influx of content from all parts of the globe—from a person in their basement in Poland to major VFX houses, to large Hollywood films to social issues.

So now I've left Story Studio and I'm working within Oculus on a section we're calling "Experiences". Because VR is much more than games, and Oculus is committed to expanding that, to funding, producing, marketing and distributing non-gaming content.

We're partnering with really well-known brands such as Disney, and as well as with indie developers. I think we'll be able to share a lot more new concepts, new discoveries, ways to make content better and more interesting.

The thing that I always evangelize is: go into a VR project with the feeling that you want to create, rather than like script. In the traditional sense of story, what is the feeling? And if it feels wrong, then there's something you have to change.

And a lot of this work is being done in a time where there really isn't a playbook. For example, Henry was an approach to experimenting with three-act structure with slight interactivity. It affected a lot of people, because it had a familiarity of storytelling, but also people felt involved. They were seeing in it a kind of invisible element of interactivity, in which Henry was able to look at you.

And though now we think about that as a small thing, being one of the first to accomplish that, for a larger, general audience created an impact. I think it also made people realized how intimacy can work within VR, and how to achieve that. Henry is really heartfelt.

Then there's a music project Old Friends by Tyler Hurd called, which is a completely wacky project: you have this crazy marching band in which everything is reactive to you. So when you look up, the sun looks at you, and smiles at you. And you're in the center of this world gone mad. [laughs].

Dear Angelica

Dear Angelica employed a traditional illustrator, Wesley Allsbrook, who came in and started drawing flat. The drawings were all scanned, until one of our coders created a drawing tool specifically for that project.

And every single line was hand-drawn by her, in that way. It created a project that no one has ever seen before. There is something powerful about the hands-on element, because humans can really connect to a human line versus a computer line.

I think VR storytelling can become less about thinking of how we see stories and movies, and more about stories that we see in our imagination. Because VR is a lot

more of how we conceptualize things or imagine things... and one way is with our imaginations and our memories, versus what our eyes see of the world.

For instance, why do we need ceilings and why do we need floors? Why do we need things to look as they are? When we have a medium in which anything can happen.

This gives the opportunity for your imagination to reveal itself outside of the things that our eyes see. And the most exciting things are the artists that are understanding that and pushing out of that.

So I think that as Henry was a great step in teaching us about how intimacy can work, Dear Angelica was a great step in teaching us how we can bend the rules of reality, which is incredibly exciting.

INTERVIEW: TED SCHILOWITZ

FOX INNOVATION LAB (2016)

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*INTERVIEW CONDUCTED BY SETH SHAPIRO

FEBRUARY 2016



Ted Schilowitz is a Futurist and VR explorer at 20th Century Fox, best-known for championing the acclaimed The Wild VR experience, a companion to the Reese Witherspoon film; and The Martian VR Experience, a widely-regarded 20 minute interactive excursion through the main segments of the feature, available on each of Gear VR, Vive and Oculus Rift. Ted is also self-professed theme park junkie who has become the best-known evangelist for VR within the Hollywood studio community. Ted was previously “leader of the rebellion” at Red Camera, and was recently announced as the new CineVangelist at Barco.

Q: What have you seen that’s interesting lately? Do you think this is the year of VR and AR?

Ted: First thing is I see tremendously interesting things all the time. However, what I would say is the vast majority of things I see are not interesting at all and don’t push the envelope, and don’t allow me to explore, and don’t challenge me. They are safe and they are inept most of the time. So now I’ll be more diplomatic, truthfully by no fault of the work that’s going on because the monetization hasn’t really happened yet, so you have a lot of people that want to get into something but don’t have the sophistication, with a budget, or the real aplomb to actually create something that’s meaningful, but they want to try, and they want to learn.

So I’m all for that, but it’s pretty clear that we’re at the beginning of a content revolution, not the middle. Which means that good and interesting things are few and far between.

Q: When you’re introducing people to VR, what’s the first thing you show them?

Ted: The thing I like to show first to people on a Gear VR is Chris Milk’s, Evolution of Verse, because it’s short, sweet, to the point, extremely immersive, takes advantage of the platform well, and is transformational. People come out of it and go, “Wow, that was amazing. There’s amazing colors, and light, and you move me up and down, and then you put me in the cradle of a giant baby at the end.” And everybody goes, “Oh, my gosh, that’s a giant baby.” It’s crazy.

And that's something that could not really be explored well in traditional media, so I think it's a valuable thing to see. When you talk about interactivity, which I think is of course critical to the success of the medium, there's a few kind of key touch points: mobile, and then we can hop up to tethered. There's a wonderful game called Esper. Again, they combine technology in story really well, the story ethos really well. So it's like an ESP journey where you control things your "mind," which means you're just moving a little thing around, but it completely works, and it's fun, and it's charming.

The other thing that I love and love to point people to to play is something called Keep Talking and Nobody Explodes, which is an interactive game that used the R plus traditional, like open a laptop, and you can do it remotely. You basically have to talk somebody through defusing a bomb, the person that's in VR. It's great.

The new Anshar Wars that's on Gear VR is really, really well thought out and done as a first person shooter, space shooter thing. And something called Gunjack, which is kind of like a reduced, refined, mobile version of "EVE: Valkyrie". Same group, CCP, did it. They're both great.

Q: What about the HMD side?

Ted: The Martian project that we did, I believe is really transformational. It is completely compelling and interesting, and it is story first technology. It's about a half hour. You live in VR for a half hour. You're using very advanced controls, so you have hands in VR, you have a body in VR. You are essentially playing the part of Mark Watney, and you're living the journey of the book/the movie, the Ridley Scott movie, and of course, Ridley was very involved in creating it. So it was a pretty big honor now for two years in a row to be accepted into Sundance for The Wild last year and for The Martian this year.

And people I don't think put the correlation together that you can't just like show up to Sundance and go, "Hi, we're Fox, put our stuff in." You have to be accepted just like a film has to be accepted and go through a curation process. So you know, you can't buy them off. They have to like it, and they say, "Come and be a part of it." So it's actually quite big thing.

Q: When you think about VR, do you think about theme parks?

Ted: So people ask what gives me the right to be a futurist, do this stuff for a big movie studio, and more than anything, it's because I grew up in Orlando, Florida. And I was a theme park kid. And I grasped and understood at a very early age the concept of immersive storytelling and believability.

The whole idea of when you go to a theme park is you're supposed to believe you went to a new place. That was what Disney was the master in.

He created worlds. And you went to “Tomorrowland,” and, “Frontierland,” and, “Adventureland.” When you went on the “Pirates of the Caribbean,” ride, you thought you were on a boat in the Caribbean. And when you went on “Space Mountain,” it’s not just a roller coaster, you’re in space, man. So the thematic and the story on top of the ride mechanics, and there was actually a thing called “Mission to Mars.”

It was a little clunky, but if you could set yourself in the believability of it, it was really cool. There was also, in a very early formative thing for me, and some people have seen it, but it wasn’t successful commercially, they had a concept called Disney Quest. There was one in Orlando, one in Chicago, and then maybe a couple others. And one of the things they had was the “Aladdin Magic Carpet” ride that was actually a true VR experience. Now this is in the ‘90s.

And you wore this gigantic bowling ball helmet thing that balanced really well, but it was like two CRT tubes and required an SGI Onyx for each system to run. The problem was throughput how do you get it through to people? And you sat on like this saddle thing, and you flew the magic carpet.

It’s like you used to have to go to the theme park, now the theme park can come to you. And that’s really what a lot of this is. Because now you can bring it home, you can make much longer form experiences. You don’t have to worry about ride throughput, and sanitation, and all these things. You’re starting to bring it home. In my talk that I give, I make a lot of reference to the Wii and how important the Wii was. Because if you think about what the Wii did, they actually virtualized entertainment experiences that come from the real world.

You were like, “This is really fun.” Imagine when it gets one step further and we can put ourselves into an experience where we get one more step of believability, which is why I often make this reference that you’ve heard me say off and on many times, and somewhat controversially, about defining the language and the semantics: are we really thinking this is VR, or is this an immersive 360 visual experience? Both of which are great, both of which can be phenomenally important and valuable... but most of the things that I see that people would call VR, I would not call VR. I would call them “immersive 360 viewing experiences,” or even, “immersive 360 mildly interactive experiences.”

For VR to be VR, people use different criteria, like presence. And that’s a defining characteristic, but for me, it’s about believability: are you in an environment where you feel like this is actually happening to you? And is most of your brain accepting it? Not all of it – because the headsets are still too crude; we still see the pixels, we still feel the physical presence of what we’re wearing – we’re still tied to a computer.

But even with all that, if it’s well-crafted and well-created, you start to believe - and you start to think, “Can I actually do this?” I look down over the ledge and I’m like... you know, it’s hard to take the step.

Not impossible to take the step, but hard to take the step. Right? At some point in the evolution of the technology, and the storytelling, and the craftsmanship from people doing this if the media at this point really finds an economic base, it will get so good – both technically and creatively – that your brain will not be able to discern whether it is actually happening to you or not. Which then opens up all these really interesting discussion points about is that a utopian world, a dystopian world, or somewhere in the middle?

Q: So when you think about immersive 360 vs.VR, is there a clear point of demarcation?

Ted: Yeah, I think it's less about the hardware and it's more about what people are doing with their creative experiences, using software and hardware. So I think you can use all the tools to create really interesting things. But I think that today, and this will always be, there needs to be a certain threshold of what the hardware is capable of to really create believability, or else you just really have a modern Viewmaster system. And there's nothing wrong with that. I mean obviously Viewmaster now released a new Viewmaster system.

But Google Cardboard, for all of its success in terms of scale and scope, is a look around viewing system. It's not a virtual reality system, although they'll be happy to call it that and sort of latch into that. I don't believe it's that. And that is by the way, not a criticism on what they're doing. It's just an awareness for me as to what is.

It's not any less awesome, it's just not the full enchilada. So that's kind of my sort of take on it. And I really like to press everybody. I want to see people keep pushing the envelope. I want them to push the envelope until the envelope starts to push back on them. That's what we did on the "Martian." We pushed so hard that, let me tell you something, it really starts to push back. You're like, "You cannot do this."

Q: The technical limitations, or the physiological limitations?

Ted: Both, everything. Yeah, all across the board. And we're right at the razor's edge, which makes it exciting.

Q: How does all of this sit in the history of storytelling, narrative, all that?

Ted: Everybody that studies media, and storytelling, and any kind of language to entertain and in form, knows this innately, is that new forms of media and entertainment emerge, the first thing most do is reach back into the older forms and try and cobble them into the new form. So when television first hit the world, radio was the order of the day, and people were literally saying, "We'll sort of put radio on this new medium."

And it wasn't until actual innovators like Lucy and Desi Arnaz said, "Not exactly. It's more like theater. It's more like a play that we can build into this little box and not people standing in front of microphones in the theater of the mind," which is radio, which is of course having a wonderful resurgence with podcasts. And I am a big fan of listening to "This American Life," and, "Serial," and, "Radio Lab," which by the way,

I highly recommend to anybody that loves storytelling. Which by the way, is virtual reality.

So I don't need a headset to create virtual reality. Listen to a Radio Lab episode or This American Life episode and let your brain be the virtual reality device. I often make the reference that the original virtual reality device is a really good book, which is you're looking at words on a page and your mind is building a world that you are seeing, and believing, and enjoying, and consuming. And when you're done with a book, if it's a great book, you felt like you went there.

"The Martian" is a perfect example of this: it's a great, great book, which means it creates the illusion of virtual reality, with nothing you're putting on your head. It's just your mind. It's just your imagination, which is more powerful than any technology I think. So that's sort of an interesting point. So radio tried to become TV, and then TV said, "No, no. This is TV." And then TVs and movies started to collide together, and people were like, "No, they're different kind of art forms. We can do different things with both."

And there you see amazing filmmakers like Alejandro which does Birdman, and then Revenant, and he's... you want to talk about pushing the envelope until it really starts to push back, to the point where they almost kill themselves out there, right? The level of filmmaking cinema is incredible.

And that is sort of virtual reality. You watch it on a big giant screen, you believe you're there. You believe it happened to you. But it's still a flat piece of media that doesn't give you the ability to move in and around it and interact with it.

What VR does so much better than other media is that: it gives you the ability to interact with the world, and move around in the world like you do in the real world, which is why we start to refer to it as virtual reality. And someone made this point, it wasn't me. Someone smarter than me made this point in a group discussion, says, "Well, we keep talking about virtual reality, but isn't it virtual fantasy more than virtual reality?" For the most part, the kind of entertainment you're creating is trying to take people to some place that isn't actually real, that isn't actually the real world.

And I said, "You're absolutely right. Most of pure entertainment is virtual fantasy." Where you start to talk about virtual reality is, "What if I can bring someone to a sports event or a thing that's happening in the news and not documenting to fill into a flat screen, I'm literally putting a camera into the world and...wow. I'm in the news."

So the believability effect is really interesting, so artists have been trying to find the medium of believability for years. And as we get better technology, better pixels, better screens, better, better, better, but it's still a pain, it's still a window to the world. Virtual reality breaks the window, like now you're on the other side of the looking glass. You are inside a world, and you can create stories that way. Almost every talk I give or panel discussion I'm on, there's always the question of like, "What about the directing and telling a narrative story and telling a directed story?"

And I say, "Look, there's a lot of things I'm really worried about in terms of what VR can be, and will it be successful, and are we creating enough of a perfect storm, and is there the right content at the right time, at the right price point, at the right marketing, and the right all that stuff? All that pedestrian stuff that makes something successful. The one thing I'm completely not worried about is that really creative people will find a way to tell really compelling stories in the new medium.

And I'm seeing it every day. We gave you some examples. Like Bullet Train is a story that is fully interactive, and you are believing this thing is happening to you, and there is a story arc. And things are going on. "Martian" is a story in VR. It's not just VR for VR's sake, there's a beginning, middle, and end. Things happen in a sequential order, but you have freedom, which you don't have when you're watching a movie screen. I guess you could leave the theater, that's your freedom. In our world, it gives you a bigger canvas, a wonderland.

The canvas is not flat, it's not just 3D, it's the canvas of real life created artificially.

Q: Is there a minimum technological threshold for that definition of virtual reality? In other words, is there 360 video tech that will just never really be VR capable, that is really apples and oranges?

Ted: I think some people might disagree with me on this, probably a lot of people would. There are amazing 360 immersive videos that I've seen that it creates incredible emotion and empathy. Sometimes people call VR an empathy machine, which I completely agree with because if it's around you, you start to believe, right? But in terms of my threshold, and maybe just because I'm doing it so much I've built a level of sophistication, my threshold of when I watch a 360 video shot with a 360 camera is I think it's amazing, and I think it's...like I look around and I start to get a sense of what's happening around me.

But I never actually believe it's reality. I didn't get on a transporter from a Star Trek and actually drop right into the war zone. I believe I'm watching someone that recorded that with a very sophisticated camera that I can look around. Because the minute I try and lean into it, or move around it, or do what I would do in the real world if I was actually in a war, like hide under the rock and try and get away from being killed, the illusion is broken. I'm stuck in space. I know that I can't actually do that, so I'm in a circle vision 360 experience. Very advanced but I'm not fully believing.

It doesn't mean it's not touching my emotions deeper than a traditional media, which it totally is, but I'm not fully believing it. When we get to volumetric motion picture capture, like we have volumetric CGI, then I think I will start to believe. Like if I was in a war zone and the stuff was all happening around me, and people were running around me, and they were running around me, and I saw them and I felt them, if I looked this way, they would sort of move around. Like I do in the real world. Then suddenly, that level of believability will get to over 70%.

Now for me, whenever I watch 360 spherical capture, of which by the way, there's some amazing work done. Chris Milk is another great example of wow, that's incredible. And Felix and Paul, there's this amazing Bill Clinton piece where you go to Africa and you're with Bill Clinton and you're in his office, and it's great But it's not real. It's great immersive 360 capture storytelling. Because I'm never like actually believing him in Bill Clinton's office. Now, if you were here and I was seeing you were Bill Clinton, and it was shot with a volumetric tool, and as I leaned in he would physically get closer to me and his coffee cup would get closer to me and his desk...

Then my lizard brain would kind of go, "Holy shit. Is this actually happening to me?" And that's virtual reality, and then a virtual fantasy, a virtual entertainment. Now the threshold is reached. So I think we're close. I think we're closer than a lot of people think. That technology is being developed, there are a lot of companies working on it, there's money being spent on it. CG does it today. That actually is the next step.

INTERVIEW: ERIC SHAMLIN, SECRET LOCATION (2017)

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*INTERVIEW CONDUCTED BY SETH SHAPIRO

APRIL 2017



Eric Shamlin is an Emmy and Cannes Lion award-winning storyteller with over 20 years of experience across multiple creative industries; film, television, visual effects, advertising and digital. He is VP, Managing Director at Secret Location, a leading studio at the forefront of emerging digital content.

Tell us about your background.

I've been working in media for about 23 years now. I started as a field producer and broadcast news producer for ABC News, covering live events and traveling to international hot spots... a lot of documentary, conflict, and natural disaster coverage. Out of all the chapters in my career, that's probably one of the most fun and adventurous. That culminated with me winning an Emmy and a couple of nominations for documentary work.

From there, I moved to the West Coast, and got into visual effects for several years at a shop called Radium. We did effects for big features and hundreds of commercials, at a time where a lot of shops were still trying to figure out what the internet was all about. I dove headfirst into tech and digital trying to figure that out. I then transitioned to a big, global digital advertising agency and led global digital media efforts for some of the biggest brands: Chevy, Nintendo, HP, Adobe, Doritos, Budweiser. I made a name for myself in transmedia... bringing substantial live action, visual effects and digital skill sets to bear on some really innovative work at the time.

And then I got a call from Apple, asking me if I wanted to join their team. Which was obviously incredibly flattering and turned into a great time; I learned a lot— it's a really wonderful group of people. Ultimately though, I decided that I'm less of a product and tech guy, and while I speak that language well, I'm fundamentally more of a storyteller and wanted to get back to my storytelling and media roots.

So I left the Bay Area, moved to LA, and started freelancing at a number of big ad agencies and production companies. I lucked out and started working with a company called Stopp, where I was blessed to work with Chris Milk, a leading voice in this industry, and Frederick Frizell, who is now the COO of Here Be Dragons.

I just happened to be in the right place at the right time working with some insanely talented people, doing probably the most innovative work in the space at the time.

Then James Milward, my current boss and President and Founder of Secret Location, heard about me. He asked if I wanted to come on board, and lead the U.S. office for them. I've been with Secret Location about two years now, and we are paving the way for the future of entertainment. It's been a great ride so far.

I tell people that I believe that 2017 is the winter of VR, there may be a lot of shops closing and some consolidation in the industry. But as far as I can tell, there's nothing but blue skies for Secret Location right now.

Q. After all of the spaces you've been in, what made you fall in love with working in VR?

The Beck Project by Chris Milk did that for me. I saw the potential of where it could go, and it was something I didn't want to let go. There's a small cohort of creative people who have done traditional and digital and games — and VR unites all those skill sets. If you see yourself as a transmedia, cross-media professional, this is the perfect medium. Because you really do need to have a good grasp of the various pre-existing media to come in and not screw things up.

And it's the birth of the medium. So to be able to play at the birth of the medium, set the rules, and get to dabble and experiment as it finds its way, finds its market, finds its adoption... I can't imagine a more rewarding place to be right now.

Q. How did Secret Location's Sleepy Hollow Experience with FOX come about?

In the summer of 2014, Secret Location was talking to Fox about doing some digital marketing efforts around their show Sleepy Hollow. This was when the DK1 had come out from Oculus, and our team was early in the Kickstarter. We got a bunch of the headsets in the office and started tinkering with them to see if we could figure out how to do VR stuff.

Then we had a meeting with Fox, who wanted us to do some digital marketing around "Sleepy Hollow." They mentioned that they had space at Comic Con, and wanted to do an experiential activation there. And basically in the room, we pitched them on this idea: "Wait, we've got the DK1, you want an experiential thing, let's figure this out. Let's do a cool VR thing for Comic-Con."

And they said yes. The problem was it was seven weeks before Comic-Con— which is a murderous timeline.

Then the DK2 came out the week before Comic Con. Which resulted in our developers being on the phone back and forth with the Oculus dev support team just to make sure it worked! There hadn't been a program that had done this yet.

That project was the first to do live action characters in a stereoscopic game engine

for VR. So it was quite a technical challenge, aside from the creative challenge. We were working with Oculus on how best to do this—how to make it a good experience, to make it work, period.

But as soon as the first consumer audience went through it, it was amazing. It was a smash hit at Comic Con that year. More than 10,000 people experienced it... just a really big success.

In the fall of 2015, Secret Location was the first company in the world to win an Emmy for a VR project. VR wasn't our core business at the time, but since that Comic Con in 2014, the phone has not stopped ringing for us to do VR. It's been a slow transition, but officially as of this past August, we shed all our VR service work, and we're now focusing exclusively on VR originals—VR narratives, VR games and VR technology.

Q. Halcyon was a groundbreaker for VR and TV. Can you talk about that?

Yes. We launched Halcyon last fall. The international version was in collaboration with SyFy International, who wanted us to develop a short-form series to fit in their interstitial windows in European markets.

Essentially you're inside a virtual environment: the living room of the crime scene. You get to interact with the crime scene, put together the puzzle of the crime scene. In between are interactive vignettes and puzzle portions, where you actually get to watch the linear episodes on the big screen TV inside the crime scene.

SyFy International had this interesting challenge, where they air U.S. formats of 22 and 44 minutes which leaves 6 minute gaps in the programming. And when they air them in Europe, they can't fill all the extra time with ads... so they were interested in using the time to test a TV show idea.

We came up with a short-form series that can also live as an hour-long drama. It's a sci-fi story about the first murder in virtual reality, and it was conceived as an hour-long pilot that was shot in such a way that we can cut it up into six-minute chapters. It aired that way, as interstitial material, in Europe and then at the end of each interstitial it would drive awareness of the VR version. So then you'd go to your Oculus, and download it and experience that. It's been a big success, and a massive series of lessons for us, as a TV/VR hybrid.

Going forward, we're very interested in building parallel universes in VR for a TV show. We have two properties which will be announced shortly, that are following on that and growing that model.

Insidious

Insidious was a partnership with Focus Features. It was great... it was another experiential 4D marketing experience. It traveled the country for months in the lead

up to the movie. Focus Features brought us on to do the experience in the world of the movie – complete with the star of the franchise. It was created in partnership with a physical construction company that built a traveling haunted house.

There were two tractor trailers that would travel to 10 different cities over the course of that year. They would pull up and construct a physical, real haunted house. Really well done, just an amazing job.

Then, if you went through the physical haunted house, you got an option for an additional chapter to the Haunted House Experience, but in VR. So you went through the physical one, and then you did the VR haunted house at the end.

The response was incredible. There was a moment when a large number of people couldn't finish it.. they kept running out. They would take off the headset and scream and leave the house (laughs).

And at first, we were like, "maybe we made it too scary!" That said, for a horror film, it was almost perfect in the end.

Q. About Secret Location

Launched in 2009 and acquired by Entertainment One (eOne) in 2016, Secret Location combines cutting-edge technology with traditional storytelling to create digitally accelerated experiences for the web, mobile, tablet, and new platforms like Virtual Reality (VR) and Augmented Reality (AR). It is the first company in the world to win a Primetime Emmy® Award for a Virtual Reality project and the creator of the first original serialized VR narrative.

Secret Location is forging the future of immersive content distribution, bringing new platforms like Vusr to market that are changing the face of entertainment. Working with the biggest VR publishers in the industry, like NYT VR, Vusr is a game-changing platform that was built by leveraging our experience in producing VR for the United Nations, Google, Oculus, GE and many others.

Q. Do you have any short- and long-term predictions for VR/AR?

In the short term, like I said, I think it is a winter of VR for a lot of companies. I think we're already seeing the 360 video market is starting to dry up a bit because of the gold rush last year. All of the major brands wanted 360 video campaigns, that will still go on. What we've learned, or what we've decided, is 360 video is a very challenged consumer medium right now. It's really hard to tell good stories in 360 video. As soon as you put a headset on, you want some level of interactivity, and so that forces you to start using game engine tools, and interactive tool kits.

For VR to become a consumer-facing medium, you have to embrace interactivity. As a studio at the forefront of emerging digital content like VR and the platforms to discover, we want to blend narrative and games where we can.

In the near term this is largely a gamer's market, from a consumer standpoint. We also think there will a lot of room for open play experiences like Tilt Brush by contributions@vrarproject.com

Google. A lot of the 360 work will dry up. Shops and brands that continue in 360 will push for more premium experiences, and better image quality but there will be fewer of them. Premium 360 will require better cameras and a higher price point. We'll continue to experiment with that stuff. It's really fun.

As a company though, we're creating more interactive, more game-like, narrative experiences.

Long term, I think location-based will play a big role— such as Dreamscape and IMAX VR. I've been to China, I think, four times in the past year. Location-based VR is going to be massive there.

I think that's going to be more of an episodic medium or short play session medium.

I also think VR games are going to explode. The rumors around the next Xbox are promising. The PlayStation signs are pretty promising. A lot of the Oculus and Vive experiences are amazing.

It also seems like all the hardware manufacturers are coming out with self-contained headsets, as a middle ground between mobile and full-on PC: a mid-tier of self-contained, more powerful 6DOF devices. That's in addition to the top tier headsets embracing wireless - for example, Oculus sneak-peaked their Santa Cruz project back in October and Vive is working on a wireless headset... so there are a bunch of companies driving innovation in that space. I think that's going to be really exciting over the next two to three years: to see how self-contained headsets and wireless 6DOF technologies gain more and more traction.

Mobile is pretty challenged, because your phone isn't really built for it. It overheats and there are processor challenges. Having a slightly more powerful mobile device that's just dedicated to VR is a really good solve for the industry, and I think it will become the mobile VR solution in the future.